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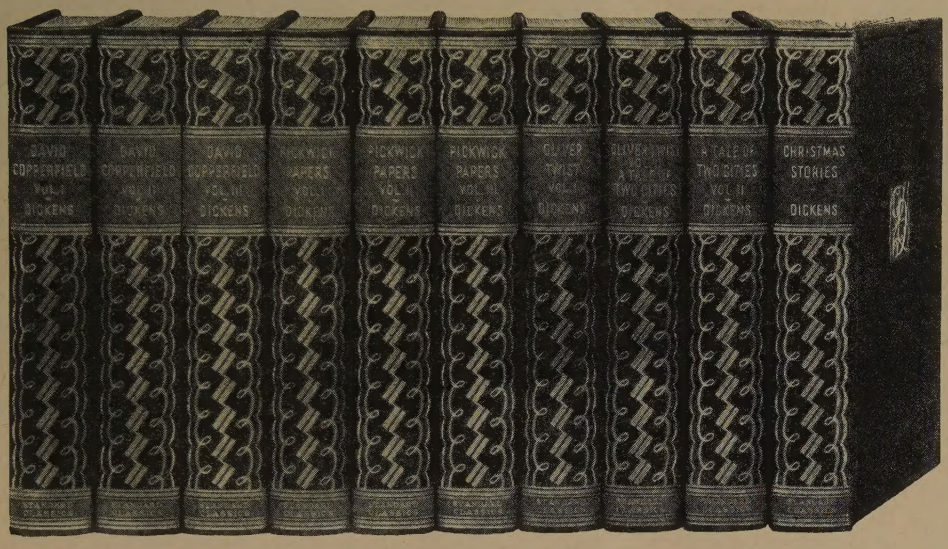
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Camera Trails

By NORRIS W. HARKNESS

Fungus growths on tree trunks and stumps make interesting pictures of the growths and equally interesting pattern studies.

Fungus Photos

For many Nature photographers December is an in-between month. The more casual photographer, who makes Nature pictures only when he has the urge, seems to lack inspiration. Perhaps he can find exciting subject matter among the fungi. These take many forms and offer perfect subjects for black and white or color. Almost any camera can be used. There was a large, heavy kind that I used to break off, dry and burn as a boy in Virginia. It grows in beautifully-curved shelves with irregular scalloped edges. A picture taken from above gives a good pattern shot, because the lower shelves are usually larger than those above, although roughly similar in shape, with their centers sufficiently off line to add variety and interest to the straight repetition.

From a forty-five-degree angle above the level of the center of the group, we get a different effect. The feeling of repetition is still there, but the angle shows more of the thickness and texture, especially when the camera and the light are at right angles to each other. The side-lighting throws tiny shadows that emphasize the texture and bring out the greatest feeling of depth, but when the sun is bright, the contrast between the highlights and the deep shadows may be beyond the latitude of the film. If the exposure is right for the bright places, there will be empty holes in the shadows, and the longer exposure that will give detail to the shadow areas will kill it in the highlights. Increasing the exposure, and then cutting the development of the film, will decrease the contrast enough to get both ends of the brightness scale near enough together to print them with full detail on soft paper. Of course, if roll film is used, and there are other subjects on the same roll, all of them will be flat and poor.

The best method of reducing the too-great contrast is to use a reflector of any light color (for black and white work) or a silvered one for either black and white or color. The reflector is held on the shadow side of the picture at the angle that throws the light back into the dark shadows. Since there is loss of light in the reflection process, such a fill-in light can never be too bright when the subject is illuminated by the same source that lights the reflector. However, the reflected light can be too harsh if the face of the reflector is too smooth, like that of a glass mirror or a shiny metal plate. A rough surface is best.

I use a card on which tinfoil from film wrappers is pasted. The 16 x 20″ card, a regular mount for prints, was cut into quarters and then fastened together with adhesive tape so that it folds into a thin 8 x 10 bundle carried in an old paper envelope. The surface is completely covered with the tinfoil, well wrinkled before sticking it on.

Most fungus pictures need a considerable depth of field and must be shot at quite short distances, which means that the diaphragm will almost always have to be stopped down as far as possible. That, in turn, means that the exposures will need to be too long for the camera to be held in the hands, and a tripod or some other solid support is necessary.

Try some fungus pictures and watch for patterns when you print. You will find an astonishing variety of subject matter and a surprising interest in the pictures you make of it, but work carefully.

This and That

According to the latest advices from Washington and Rochester, the long expected curtailment of both films and flashbulbs is about to arrive and may have been put in force by the time this is printed. The WPB apparently has ordered the discontinuance of certain flashbulbs and blue photofloods, and has restricted the sale of those that remain to government agencies and publications with high priorities. As this is written the order has not been published and some changes may be written into it, but as it now stands there will be few or no flashbulbs for amateur use for the duration. Proper use of reflectors will enable us to go on with nearly all outdoor pictures, and most of those we have made indoors can be made almost as well with floods as with flashes although with greater inconvenience.

The Rochester factories have been forced to impose a sort of rationing of film on the dealers, but as now announced it does not represent any material reduction from the delivery levels of recent months. It is based on a percentage of shipments made in corresponding months last year and covers all types of film. For the next few months there is no sign of any reductions to a point that will interfere with normal amateur activity, but for the duration it is even more necessary than ever that we think a bit more before making exposures and not rely on the shotgun kind of shooting that depends on a number of shots in the hope that some one of them will be right. We dare not waste any kind of photographic material.

Both these restrictions, small though they are in their effect on any one amateur, are brought about by the tremendous requirements of the military services and the consequent shortages in available supplies. The authorities have announced their intention to leave for amateur photography every bit of material that is not definitely needed by war agencies, and the probability is that we shall never find ourselves without sufficient supplies unless some of us are unpatriotic enough to resort to hoarding. Amounts of film and paper and chemicals are being manufactured far in excess of the military needs and with sensible use of

those available to us, there will be no time when we cannot get all that we really need. Use but do not waste. Photography has a large place in maintaining morale and we should continue to take advantage of its help by cooperating in every way possible.

An important way to cooperate is to save all film spools, film pack metal and all other metal containers and return them to your dealer, who will send them back to the proper factory to be reused. It is a vital part of the country's scrap drive.

December is the last month of the Red Cross Awards, the nation's greatest camera contest. See the details in this department last month. Check with the heads of your local chapters to see what the picture opportunities are, and then arrange with them and the camera clubs around you for a Red Cross Camera Field Day to put on a big, well publicized exhibition of what is being done. Get all the photographers to come along and make pictures they can enter in the Red Cross Awards.

You have seen the *Life* stories on the value of amateur pictures in helping the military plan raids and, someday, the invasion of enemy-held territory. If you have traveled in foreign countries and made pictures of those countries, the government wants to see them to get what information they may contain.

The Office of Strategic Services is collecting such pictures and asks that you write them for a questionnaire. Do not send in prints or movie film now. Write the Office of Strategic Services, Box 46, Station G, New York, N. Y., and ask for your questionnaire.

This and That to this point has been warlike, but these are warlike days. So is the news, and so is the chief interest of any American. But this month brings us the day of celebration of the greatest peace—Christmas. It is a day to forget war and struggle, a day for the assembled family to enjoy together, a day for the young of all ages, with or without the benefit of the camera. It is a day for some of the finest pictures that will mean much as long as you live. Do not forget to make pictures of the youngsters in their enjoyment of what Santa Claus has brought them, or portraits of the family gathering. And do not forget that one best picture to use on your next year's Christmas card. Last of all, do not forget that I am wishing you and yours the finest kind of Christmas and the best of all New Year's.

The Question Corner

Those of your questions that seem to be of general interest will be answered in the Question Corner. Both these and the questions that have no such wide value are also answered by mail.

J. D., Kennebunkport, Maine, asks: "How can I bring out the full fogginess of the early mornings here? I have used the yellow you recommend for general use and no filter at all, but there is less fog in the pictures than I saw. Is there any way of making the exposure to give more emphasis to it?"

ANS.—The answer to your question lies in what happens to light in fog. You have seen pictures made with infra-red film in which details completely hidden from the eye by fog and clouds are clearly shown. The infra-red film, sensitive to the invisible rays below the red end of the spectrum, gets the rays that penetrate the fog while the yellow and blue rays that we see best are diffused by the particles of moisture. A red filter that admits the red rays will act to some extent in the same way by keeping out the diffused blue light. Therefore, if you use a blue filter to keep out the more distinct red image—and thus use only the blue component of the light—you will have the maximum fog effect. Using no filter on the lens is better for your purpose than a yellow, orange, green, or red, but the blue will do the work best with either pan or ortho film.

G. T., Houston, Texas, writes: "I have trouble with grain in most of my negatives to the point that I can rarely get a good 8 x 10 print from them. What causes it?"

ANS.—Technically, graininess is the clumping together of the silver grains in the emulsion, but I wish I knew what makes the microscopic particles do it. A grainy emulsion, too much development, or too violent a developer are the most frequent causes, but the uniformity of temperature during processing, the violence of the agitation, the speed of the drying, and the exposure are sometimes blamed for it. Undoubtedly they, or some of them, do contribute to the grain. Using a medium speed film, a fine-grain developer in strict accordance with the manufacturer's directions, and the greatest possible care to keep the temperature constant will help to reduce it. Agitate the tank gently and dry the film as fast as you can without applying heat—and hope for the best.

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To Stimulate Public Interest in Every Phase of Nature and the Out-Of-Doors, and Devoted to the Practical Conservation of the Great Natural Resources of America

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Amateur Scientists

The Amateur Scientist. By W. Stephen Thomas. New York. 1942. W. W. Norton and Company. 291 pages. Illustrated. $3.00.

"The supreme importance of science, and the methods of science, in the present world crisis is being recognized today as never before," writes Edwin Grant Conklin in a foreword to this interesting book. "Every informed person knows that this war will be won by the utilization of scientific discoveries, or lost by failure to use them. But relatively few persons realize that scientific-mindedness on the part of nations is the most important preparation for peace as well as for war."

In this the amateur scientists play a vital rôle. It is from their ranks that recruits are drawn; from their studies come facts, clues and discoveries of inestimable value. The author of this book has had an excellent opportunity to prove this as executive secretary of the Committee on Education and Participation in Science of the American Philosophical Society. This Society conducted a notable and valuable study of the work of amateur scientists in the Philadelphia area, and it is on the basis of this that Mr. Thomas has built his book. He discusses the amateur scientist, his place in the community, his organizations, his results and his importance for the future.

The result is a comprehensive picture of the amateur in the scientific picture; and enlightening and inspiring compilation of facts and suggestions. While we believe that Mr. Thomas' book would have been given more practical value had it contained an appendix of source material and listing of amateur groups, after the manner of Edwin Way Teale's excellent *Byways to Adventure*, the lack of such aid does not detract from the significance of the volume.

The CCC

Saga of the CCC. By John D. Guthrie. Washington, D. C. 1942. American Forestry Association. 50 pages. Illustrated. $1.00.

The Civilian Conservation Corps has become history. Under the impact of war the corps' varied activities have been terminated, the camps closed or turned over to the Army. So ends one of the most popular innovations of government. But although *finis* has been written to this unique and colorful phase of American life, something of its departed color and spirit has been made permanent in a little green volume entitled "Saga of the CCC," written by Major John D. Guthrie and illustrated by the pen drawings of Marshall Davis.

No one could have brought to the task of writing this saga a more intimate and realistic background than Major Guthrie. He has known the CCC since its beginning back in March, 1933. He was CCC Liaison Officer at Fort Sam Houston for more than a year, and since that time has been a general inspector of CCC camps under the Department of Agriculture. He has seen thousands of camps in every corps area and in almost every state, and out of his knowledge and sympathetic contact, he has written this book in blank verse style about the CCC enrollees—how they lived, how they worked, and what they meant in the American scene.

The Marshall Davis drawings are excellently done. There are sixteen full-page illustrations alone, each adding its own quality of life to the written word. For Davis too knows his CCC enrollee. He was one. He lived in the camps and knew the camp ways, and his pen sketches catch the very essence of the tragedies and triumphs that made up the life of the CCC.

The CCC will not lack for monuments to its brief but lusty years of living—miles of roads and trails and firelines, thousands of seedling trees, and fire towers, all testify to their activities. But the corps needed a historian. Now, through the medium of this attractive green booklet, it possesses one in Major Guthrie.

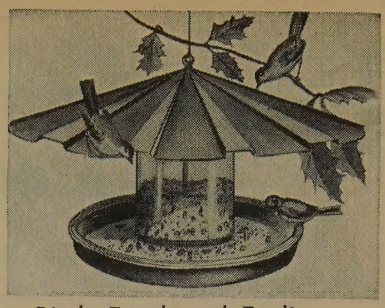
Exchange Pictures?

Harry L. Johnson, South Meriden, Connecticut, is actively interested in wildlife photography, particularly in Kodachrome. He has specialized in flowers and insects of his region and would like to exchange with others, similarly interested, in the South and West. He would even like to purchase some slides.

Lady Lion-killer

The Lady and the Lions. By Bess Kennedy. New York. 1942. Whittlesey House. 221 pages. Illustrated. $2.50.

This is the story of a young Texas woman, extremely easy to look upon, who, in 1936, became an official United States Government predatory animal hunter—object, mountain lions and other animals preying on domestic stock. It is an entertaining and informally-written story of her adventures.



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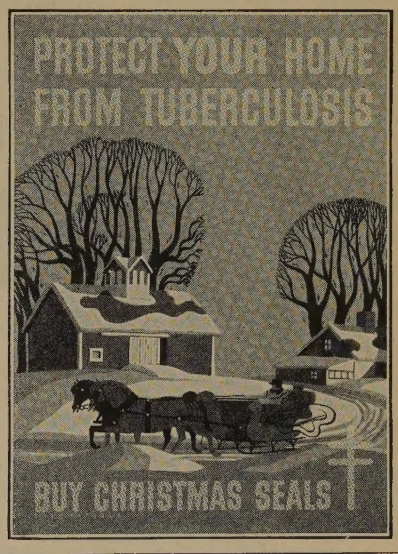

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U. S. PARA-SKI TROOPS

Contents Noted

Poring over Japanese zoological literature, Dr. Wilfred H. Osgood of the Field Museum in Chicago has found a tip on Nipponese Asiatic policy. While we were treading gently to avoid offending the Japs, and they were arming and developing the mandated islands they had agreed to run on a non-military basis, they were also appropriating the fauna of the islands for their own. A Japanese zoologist five years ago listed the mammals of these islands as Japanese, as well as those of Korea, which takes in the fauna of eastern Asia. Were a British naturalist to apply the same principle he would have his hands full.

Regularly on the first Monday of the month—and irregularly in between—Mrs. Charles Cyrus Marshall, and the good ladies associated with her in the National Life Conservation Society, put on a lunch for men in the services, and then see that their guests get an informal and interesting tour of the American Museum of Natural History. Luncheon is held in the Museum restaurant, and already soldiers and sailors from almost every state, as well as those in the uniforms of most of our Allies, have been entertained. Letters of appreciation have come in from the boys now located all over the map. It strikes us that Mrs. Marshall has an idea that could well be copied by groups all over the country where such interesting institutions as the American Museum are available. Natural history museums today are, for the most part, pretty exciting and dramatic places.

Translating the calls of birds into man's terms strikes us as a most inexact and often a rather useless activity. Translations vary widely. We know, for example, that a cardinal in our neighborhood stridently calls our next-door neighbor, shouting, "Herbie, Herbie, Herbie. Come here. Come here. Come here." Others think the bird is saying something else. From Grass Valley, California, one of our readers writes to say that a California quail in a canyon near his home distinctly calls: "Mac A-a-a-r thur, Mac A-a-a-r thur." Our correspondent hopes that those who hear this call will think of the General and his men out there in Australia and the South Pacific islands offering their lives that the rest of us may continue to live as free men. It might be an idea to mobilize these quail and let them infiltrate the Jap lines, calling as they go.

Our hopes were rudely dashed by a recent U. S. Department of Agriculture release stating that tests of the sulfa drugs failed to kill insects. The idea had occurred to us one evening last summer just after a friend had made a startling comeback from incipient pneumonia, thanks to sulfa-somethingorother. The mosquitoes that evening were specially blood-thirsty, which moved us to observe that a spray concocted of the sulfa drugs might lay them as low as these new medical weapons do the pneumococci. Now come the government scientists who tried out a score or more combinations on codling moth larvae with no bother to the larvae. We still will not be satisfied until they are tried on mosquitoes.

Treading gently but none too securely, Sweden continues, at this writing, to maintain her neutral status. The American-Swedish News Exchange, Inc., with headquarters in New York, has burgeoned into life with releases for American consumption on goings-on at home. Like all such hand-outs in these days, we read the items with mental reservations. A recent release, however, is a relief from war-tinged stories. This note reports that a professor at the University of Lund has added up and found that there are 24,150 known species of animals in Sweden. Of these 17,300 are insects. A new species of shrew mouse was discovered last year, and a new flax-finch and a new warbler have recently been added to the bird lists. No estimate is made of the number of elusive rodents of the tribe *Rattus quislingus* among Sweden's fauna.

Those Americans who may this winter be disposed to wail about a temperature of sixty-five degrees in the living room, because of problems of fuel oil distribution, should give a thought to the men on the frigid islands of the North Pacific—our fighting men who have to take it whether they like it or not. The wind practically never stops blowing icily across these rocky, treeless isles. In fact there are species of beetles that in other parts of the world have wings, but in this region have developed flightless races so they will not be blown to sea.

R. W. W.

A free American family, in a free America—where millions of acres of parks and forests are the property of all the people—is enviously hated by our enemies. Men are offering their lives to protect that freedom. The rest of us must be satisfied with investing in its protection. BUY BONDS.

PHOTOGRAPH FROM HAROLD M. LAMBERT

The story of the metal workers of antiquity reveals theirs to be—

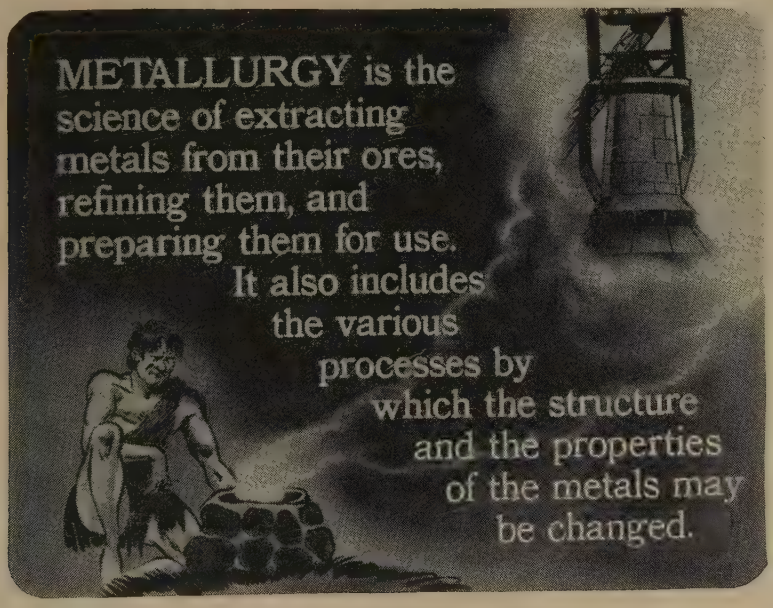
The Most Ancient Art

Illustrations by The Jam Handy Organization

By EUGENE W. NELSON

It has been truly said that "the best way to appreciate the present and prepare for the future is to study the past." Today, when the fate of the world may well depend heavily upon the skill and the ingenuity of the metallurgist, it will repay us to spend a few moments looking at the beginnings of what may well prove to be the oldest of all the arts.

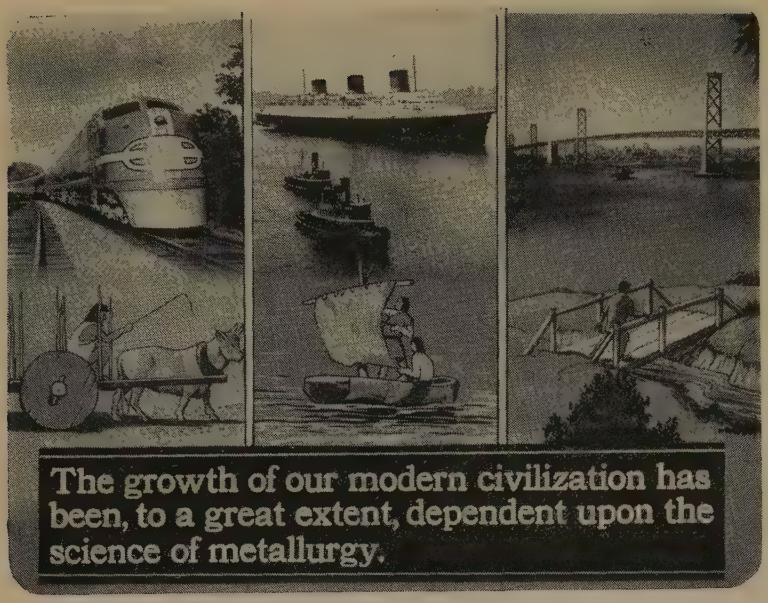
The worker in the laboratory will tell you that metallurgy is the science, and the art, of extracting metals from their ores, refining them, and preparing the resultant metals for actual use. Metallurgy also includes the many and varied processes by which the structure and properties of metals are changed, such as rolling, forging, swaging, stamping, heat treating, and many others. Metallurgy is, indeed, a broad term, as well as an advanced and highly specialized science.

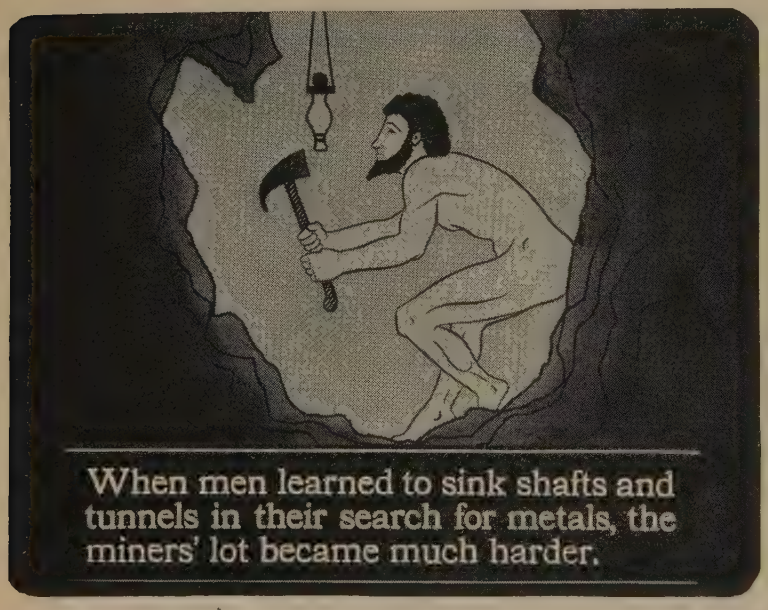

METALLURGY is the science of extracting metals from their ores, refining them, and preparing them for use. It also includes the various processes by which the structure and the properties of the metals may be changed.

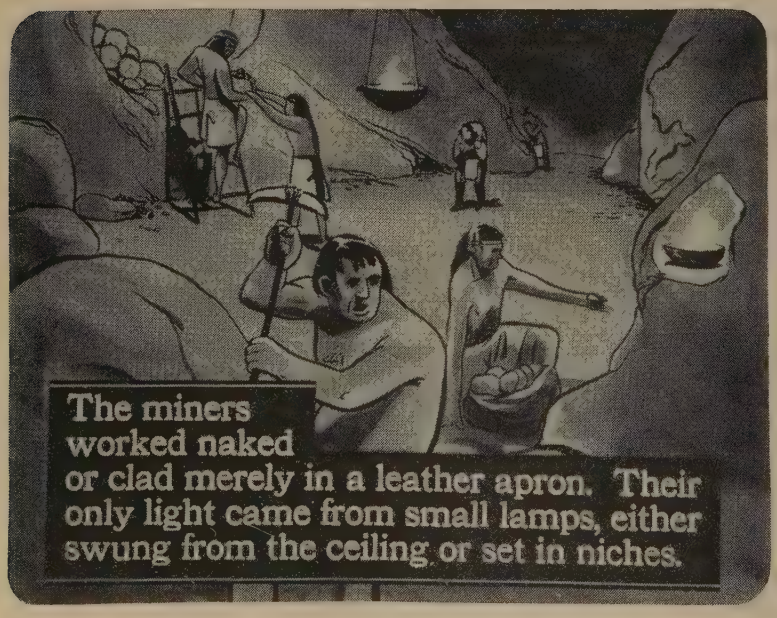
The growth of our modern mechanical civilization has been, to a great extent, dependent upon this science. Today, more than ever before in all history, we live in an age of metals. Some call it the Iron Age, others the Age of Steel. Still others prefer the Aluminum Age, or even the Age of Alloy Steels. It does not matter. They are all metals, and they form the framework of today's world activity.

The metallurgist has now some sixty-five metals at his command. He knows how each of them will perform under all sorts of conditions; under extremes of heat and cold, tension and pressure. He and his fellow workers—the chemist, the physicist and the mineralogist—have compiled a staggering amount of technical data on alloys made up of from two to six, or even more, individual components. They have even broken down the metallic elements and learned the arrangements of their atoms and molecules. They have produced alloy steels with many times the strength and resistance to corrosion of the old-time products. They have perfected alloys of aluminum and magnesium that have made possible the gargantuan air liners of today, with their speed of three hundred miles an hour. Studies have brought into existence such complicated marvels as automobiles, refrigerators, skyscrapers, and television. In fact, there is scarcely a field of human endeavor that has not been improved—and in some cases made possible—by the work of the metallurgist and those allied with him.

Constantly surrounded as we thus are by so many evidences of the metallurgist's skill, we are likely to think of them as exclusively the products of our own times—of the past fifty years. This is far from the truth because the metal workers of antiquity laid the foun-






The miners worked naked or clad merely in a leather apron. Their only light came from small lamps, either swung from the ceiling or set in niches.

dations of this science upon which present-day research has erected our intricate mechanical civilization. To appreciate fully the broad scope of the work of the ancient metallurgists, and the many difficulties that confronted them in their epic struggle against a cruel and savage environment, we must go back into time and start with the very beginnings of the art.

We must go back into the dim mists of the past. We must go back into that time before a crude litter of mud huts called Rome was built on the banks of the Tiber River; before the pyramids were erected in Egypt; before the Great Flood laid waste the fertile Valley of the Euphrates. We must go back some eight or ten thousand years in time, and many hundreds of miles in space, to somewhere in the Near East. It is generally agreed that the first intentional use of metal occurred in that part of the world and not in Europe.

There—in some locality as yet unknown—men took their greatest single step forward when they discovered that there are in the earth certain substances that appear to be rocks, but which have wonderful properties not possessed by ordinary stones. We can imagine early man searching among the foothills and outcroppings for suitable pieces of flint from which to make his tools and weapons. Accidentally he finds pure nuggets of gold, copper, or, perhaps, silver. Properly cleaned, such nuggets appealed strongly to men and women because of their beauty, and so the first finds of metal were used merely as ornaments.

To acquire more such beautiful trinkets, men began to seek far and wide to locate as many as possible of these queer, heavy lumps. In fact, our modern word, "metal", is derived from the ancient Greek "metallon", which means "to seek." Eventually, some ancient Edison discovered that these queer, attractive "rocks" could be worked into a variety of useful and pleasing shapes by hammering; that they could be formed much more easily than flint can be chipped.

Those first crude tools, weapons, and ornaments were laboriously hammered from the non-ferrous metals upon stone anvils. They were the heralds of an era of progress destined to end the Stone Age. This discovery also ushered in an earnest search for more and still more metals among the rough and rugged hills of early man's homeland.

As man's natural instinct for acquisition and development led him to delve farther

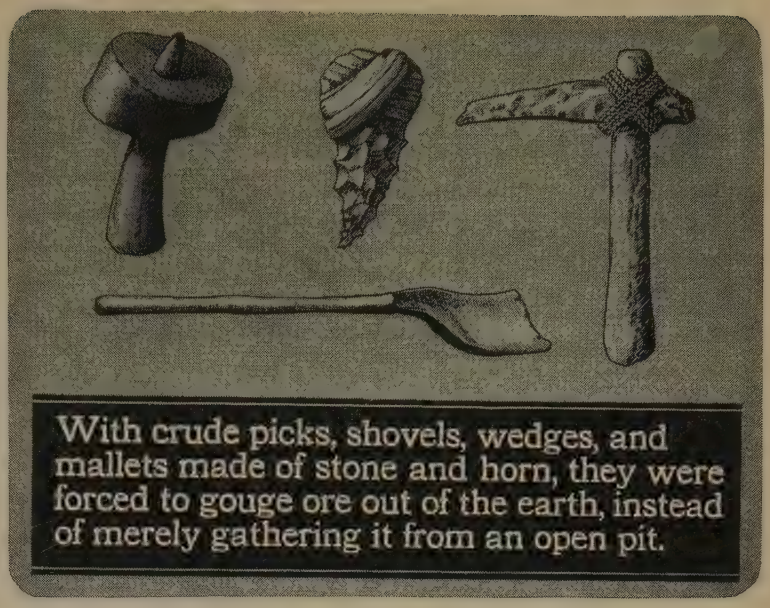
into the ground in his efforts to wrest mineral treasures from Mother Earth, mining as we know it began. All the earliest mining was of the surface variety; the ore was simply scooped up from open pits. Remains of large mines of this sort have been discovered in Egypt, China, and India. They date from at least 4000 B.C.; perhaps even 5000 B.C.

In those early days of organized open-pit mining, after the rudiments of town and city-state government had been developed, the miners were almost always either captive slaves or condemned criminals. Since there was always plenty of such cheap labor available, the mine owners had no incentive to foster technical progress or to invent machinery to save time or lighten labor. And when men learned to sink shafts and tunnels in their search for metals, then the lot of the miners became unthinkably harder.

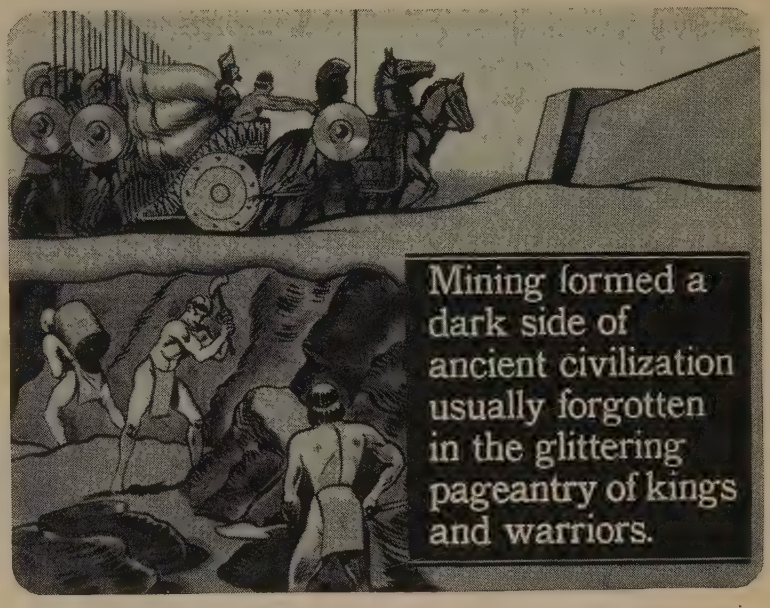
The miners were so poor, and the heat in most of the mines was so sweltering, that the workers went naked or were clad merely in protective leather aprons. Their only illumination came from small lamps, either swung from the ceiling or set in niches cut in the walls. For tools, the miners had crudely made picks, shovels, wedges and mallets of stone and horn. With these they were forced to gouge the ore out of its rock matrix instead of merely gathering it from open pits as had their forefathers. Sometimes, however, the miners were not even provided with tools, but had to scrape the ore from the mine shafts with their bare hands. Even today, an old Roman-operated mine in Spain still shows the imprints of thousands of human fingers in its hard clay walls, mute testimony to the crude and brutal methods of mining in those times.

Such procedure made it necessary for the tunnels to follow the ore veins as closely as possible—both as to direction and size—due to the terrific task of removing any material at all. This permitted a forward progress of about thirty feet a year! The size of the tunnels established the position in which the miners worked—standing, sitting, or lying—and many tunnels were so small that only children could enter them. This custom may well have been the origin of the many legends concerning gnomes and dwarfs as miners.

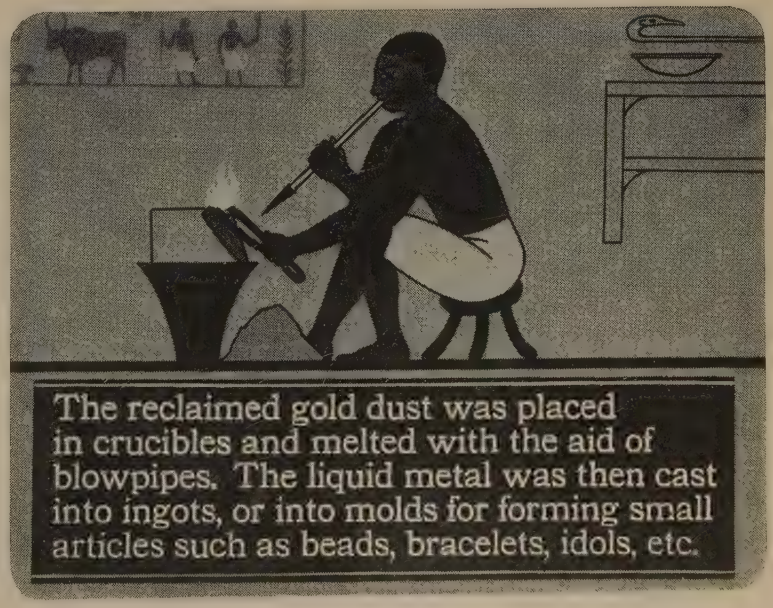
Needless to say, no precautions were ever taken to prevent accidents. No walls were ever shored up and no ventilation was afforded. If a miner died, or was crushed by



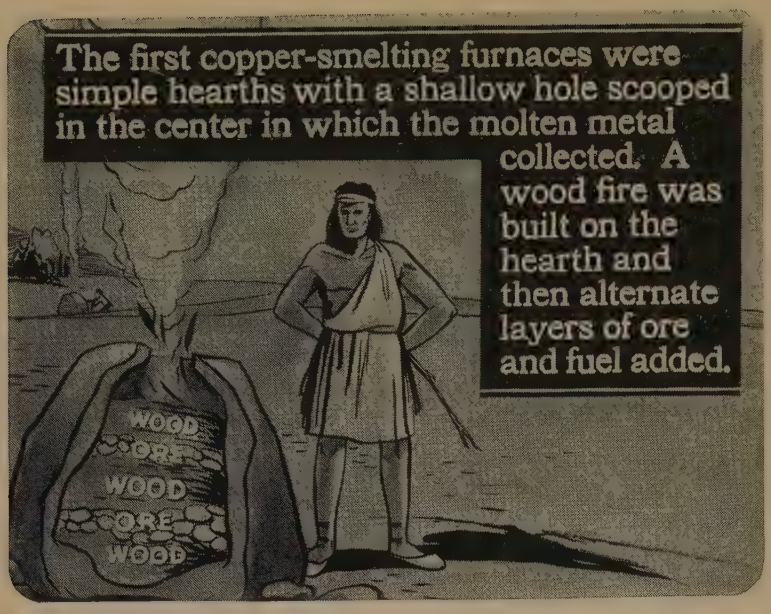
With crude picks, shovels, wedges, and mallets made of stone and horn, they were forced to gouge ore out of the earth, instead of merely gathering it from an open pit.

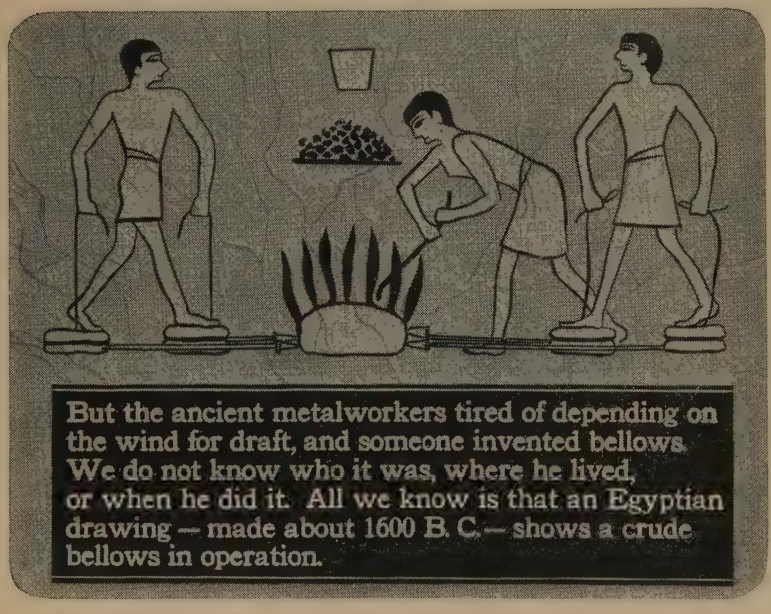


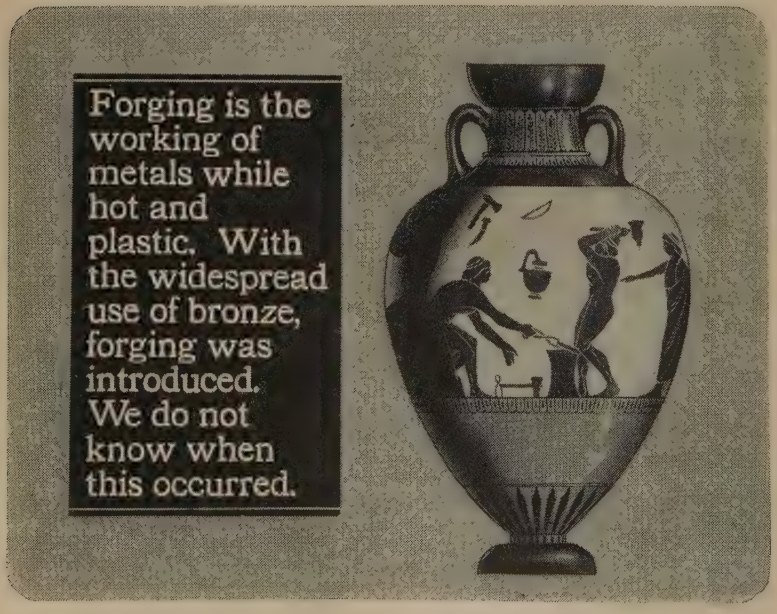
Mining formed a dark side of ancient civilization usually forgotten in the glittering pageantry of kings and warriors.



The reclaimed gold dust was placed in crucibles and melted with the aid of blowpipes. The liquid metal was then cast into ingots, or into molds for forming small articles such as beads, bracelets, idols, etc.


The first copper-smelting furnaces were simple hearths with a shallow hole scooped in the center in which the molten metal collected. A wood fire was built on the hearth and then alternate layers of ore and fuel added.
WOOD
ORE
WOOD
ORE
WOOD


But the ancient metalworkers tired of depending on the wind for draft, and someone invented bellows. We do not know who it was, where he lived, or when he did it. All we know is that an Egyptian drawing — made about 1600 B. C. — shows a crude bellows in operation.


Forging is the working of metals while hot and plastic. With the widespread use of bronze, forging was introduced. We do not know when this occurred.

a fall of rock, he was buried where he fell. Human life was very cheap, and being condemned to the mines was equal to a death sentence. The toll in human life and agony throughout the centuries was unbelievable since mining and ore-handling went on without heed of the furnace air of noon or the damp chill of evening. Mining made a dark page in the history of the ancient civilizations, and one usually ignored among the glittering pageantry of kings, priests, and warriors. Yet despite these brutal and unprogressive methods, many ancient mines were worked unceasingly for hundreds of years. Their main shafts eventually attained depths of nearly a thousand feet and their tunnels covered vast areas.

Of course, the task of refining the ores and working the resultant metals had its dark side, too, but at least a part of this work was carried on in fresh air. After the ore was gouged out of the mine, it was tossed into leather sacks, which were carried to the surface of the ground. Then, if the ore was the gold-bearing quartz rock from Nubia, which lies south of Egypt, powerful slaves beat the rock to powder with heavy stone mauls.

The powder was bagged and went to Egyptian refineries in overland caravans, or by boats down the Nile River. In the refinery, the gold was separated from the rock by putting the powdered ore on a board and sluicing water over it. The rock dust was washed away, leaving the heavier gold particles. The reclaimed gold dust was melted in crucibles with the aid of blowpipes. The liquid metal was cast into ingots or molds for forming such articles as beads, bracelets, and other things.

Copper ore from Cyprus and the Sinai Peninsula; tin and lead ores from Asia Minor; silver ore from Greece; and, after 1400 B.C., iron ore from many places, all had to be refined with fire in furnaces. These were the metals with which the men of old worked.

Today, we have plants for refining ores covering acres of ground. There are blast furnaces that tower a hundred and twenty feet in the air. In ancient days, the furnaces were poor little affairs built of fire-baked mud bricks with a simple refining hearth inside and a channel leading away from it so the pure metal could be drawn off. Often enough the furnace was nothing but a hole in the ground where the ore and fuel were dumped together. The earliest smelting furnaces, around 3500 B.C., were construct-

ed on windy hillsides to take advantage of the intense heat created by the draft.

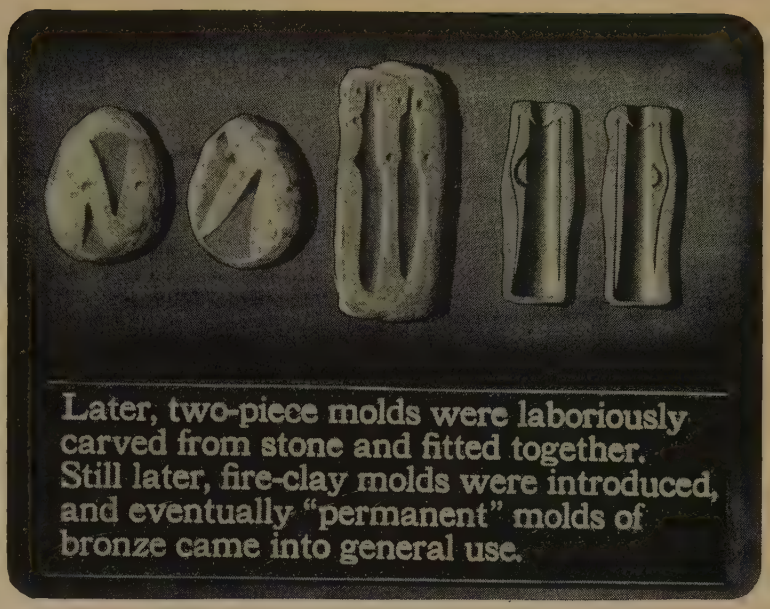
Eventually, the ancient metal workers tired of depending upon the vagaries of the wind and someone invented the bellows. We do not know who it was, where he lived, or how he did it. All we know is that an Egyptian drawing—made about 1600 B.C.—shows crude bellows in operation. They were made of skin bags fastened to frames that held them in position, and were provided in front with a reed wind-pipe reaching nearly to the fire. The tube had a clay nozzle on its tip to prevent burning. When in use, a man stood with one foot on each of the two bags, holding in either hand a cord with which to *distend* the *flattened* bellows. So while pressing air out of one bellows, the workman pulled up the other to inflate it again.

After the metals had been refined as well as possible—and often it was not very well—they were subjected to many processes for shaping into useful objects. Many of these processes were basically the same as the ones used in the great mills today. Hammering the metals while cold was the first method used to fashion tools, and must have been discovered as early as 5000 B.C. Later men learned that, unlike rocks, metals can be beaten into shape more readily if heated red hot. This is called forging. Forging has a respectable antiquity, for there has been found a bill (unpaid) inscribed on a clay tablet from a smith to a soldier for forging a set of bronze weapons. The bill dates from around 3000 B.C.

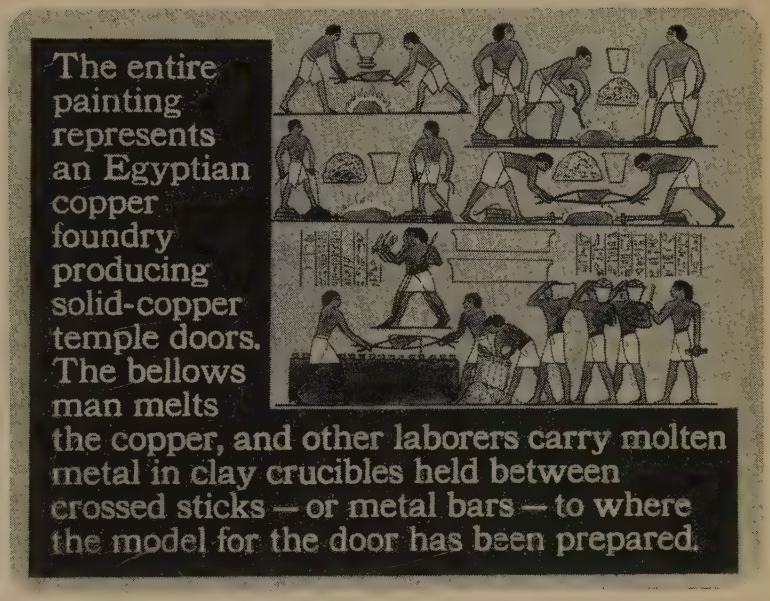
Bronze, a mixture of about ten percent tin and the rest copper, was the most popular metal for forging. The use of bronze in those days, however, depended on the tin supply, which was never steady. Bronze itself was in use as early as 4000 B.C., but in many cases a nation would run short of tin and have to revert to the plain copper standard.

The tools of the smith were the anvil, hammer, tongs, and bellows, as we can see from various pictures of the Greeks and Romans. After 1000 B.C., iron had become common enough so that instead of being used for jewelry it was forged into tools and weapons. Homer mentions this often in his "Odyssey."

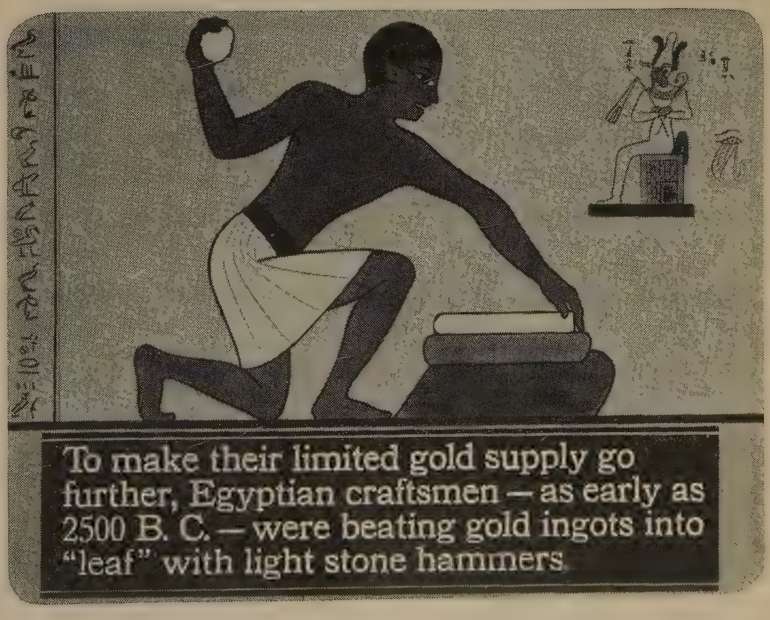
Sometime between 4000 and 3500 B.C. the ancient metal workers made one of their greatest discoveries. This was that metals will melt if heated hot enough, and can then be cast into molds where they will



Later, two-piece molds were laboriously carved from stone and fitted together. Still later, fire-clay molds were introduced, and eventually "permanent" molds of bronze came into general use.



The entire painting represents an Egyptian copper foundry producing solid-copper temple doors. The bellows man melts the copper, and other laborers carry molten metal in clay crucibles held between crossed sticks — or metal bars — to where the model for the door has been prepared.



To make their limited gold supply go further, Egyptian craftsmen — as early as 2500 B. C. — were beating gold ingots into "leaf" with light stone hammers.

harden and retain the desired shape. This sounds simple to us, but it must be remembered that early man considered metals as nothing but unusual rocks. He could not melt rocks, so why should he try to melt metals?

At first, the molten metal was poured into crude molds pressed into the earth. Objects made this way were finished by cold hammering. Casting stepped up production and made metals more valuable than ever. Later, two-piece molds were carved from stone and fitted together. Still later, fire-clay molds were introduced, and, eventually, "permanent" molds of bronze came into general use.

On the wall of an Egyptian temple dating from 1600 B.C. there is a drawing showing how the copper doors for the temple were made in the foundry by casting the metal in molds. Here we see Egyptians working bellows, melting metal, and carrying it in cups supported by crossed sticks to where the mold for the door has been prepared. Funnel-shaped cups are inserted in this mold and the metal is being poured into them while slaves bring sacks of sand from which to make other molds.

Casting in *solid* metal was practiced for centuries before the ancient metal workers learned to make *hollow* castings. This was another great metallurgical achievement, for it lightened the objects and saved metal, thereby reducing the price of cast metal wares. Reduced manufacturing costs—then as now—opened up new markets for merchants since the poorer people could now afford to buy metal goods.

In addition to these basic principles of metallurgy, the ancients had several other lesser skills that we have inherited. They knew the value of *plating* with metal, both to beautify an object and to preserve it. Thus it was that the Egyptian craftsmen, as early as 2500 B.C., were beating gold ingots into "leaf" with light hand-stones. They became so expert at this work that they could make one pound of gold—little more than a cubic inch—cover a six-foot square. This record was not excelled until the Eighteenth Century A.D. Later, tin was used for plating and the Romans preferred cooking vessels covered with tin because they did not corrode as did plain iron pots. This was the start of the tin can industry.

Water pipes were made from sheets of pure lead, and the lead pipe industry was one of the biggest businesses in Rome. Welding, the joining of two metal pieces with fire, dates from about 1500 B.C., since welded pieces of copper from that period have been found in Egypt. Soldering, joining two metal pieces with fire and an alloy, originated in Babylon before 2500 B.C. Solders of gold and silver were used. The Romans made better solders out of tin and lead, which is practically the same as the solder we use now. Brass making was also practiced to a limited extent. Ground zinc ore was heated with copper, giving brass, which was used mainly for ornaments and coins. Zinc metal was not isolated until near the end of the Middle Ages.

This was about the extent of knowledge of the science of metallurgy that men possessed at the time when Rome fell. After that event, the light of civilization went out all over Europe and no progress was made in mining and metal-working techniques for about ten centuries. No, the ancient metal workers were not miracle men; they had no mysterious, secret arts that died with them; they could not harden copper; their steel was not as good as ours; they groped in the dark and blundered woefully with their slow and brutal methods.

But to these same men we owe the discovery of gold, silver, copper, tin, lead, and iron. In addition, they gave us mining, smelting ores with fire, melting and casting metals, cold working, hot forging, plating, soldering, welding, heat treating, and alloying—an imposing list of achievements. Our debt to them is vast, for they built a strong, practical foundation for this science. They were the ones who made the really great, and truly important, discoveries. Stainless steel is of less value than the knowledge of how to melt and cast metals; forging iron and bronze is more important than the invention of strong alloys of aluminum and magnesium.

With all our science and modern equipment, we have contributed less to the art than the ancients.

★

In The Dunes

By WADE VAN DORE

Too dry to be water,
Too loose to be land,
No ship has come hither,
No wheel rides this sand.

No man has come near
With a dream in his brow
Of forests to fall
And new soil to plow.

No mouse builds a nest,
No deer looks for cover.
No worms bore for food,
And no butterflies hover.

Within this desertion
I stand or I plod
As one in a hushed,
Private garden of God.

There seems to be only the calm of death,
but life goes on in snowy wastes—

When Ermine Robes the Evergreens

By JOHN LINDSEY BLACKFORD

THERE had been signals of momentous change in the November air. Cold had come; bitter cold, strangling the rivers, locking the lakes and ponds. As it grew less intense, a ceiling of leaden cloud pressed down, engulfing in formless smother all but the nearer slopes of the foothills. Slowly, idly—then rapidly, densely, determinedly, snow was falling. Almost ceaselessly it fell; transforming the verdant forest; robing it in spotless ermine.

The sudden change from bright, colorful autumn days to biting, pitiless frost and swirling snow seemed like the rude breaking of a promise. Yet I thrilled at the challenge to all wild things during those cruel, barbaric days of storm.

Finally the cloud mass lifted and broke. Eastward was flung the ragged wrack of the storm. A morning came, bright, chill, dazzling. Only a few wisps of frosty cirrus floated far above in the high cloud region. Winter had come.

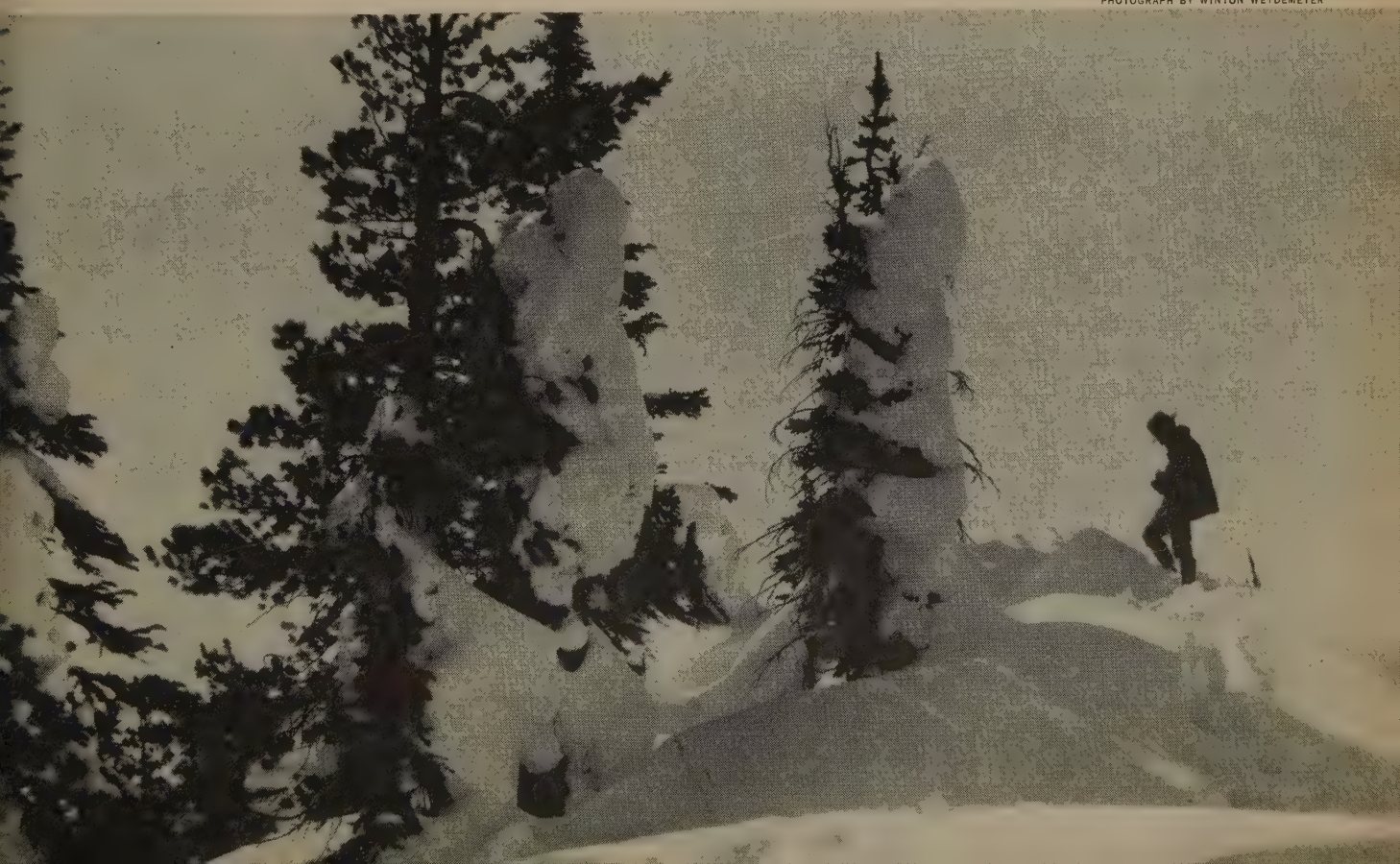
To a bird lover occurred the natural questions: How had our winged friends fared? How might they endure and pass this forbidding season? Old questions, but filled each year with new wonder, as if forgotten.

The majority meet winter's challenge undaunted. They are well prepared for its trials. Their food supply is, in a measure, ready and secure. They are our true winter residents—woodpeckers, nuthatches and chickadees, crossbills, grosbeaks and grouse. But what of others that bird lists and an occasional meeting tell us are here? Who are they, and where do they keep themselves while snow buries their accustomed haunts and icy blasts lash their summer refuges.

From the rock-girded flank of a mountain I survey the wintry scene. The river, a broad crystalline path, glitters beneath, swerving into distance. Its deciduous borders, so lately a maze of leafless branches, are spun into gauzy traceries of white. Beyond, the evergreens sweep away or assail the mountain wall below. Every conifer thrusts up a silvered spire; every evergreen droops boughs of argent splendor. Far beyond—startlingly close in the frost-cleansed air—the peaks toss up a jagged backdrop to this scintillant world.

Not far below, a broad creek empties through sprawling channels into the river. Here and there a

PHOTOGRAPH BY WINTON WEYDEMEYER



PHOTOGRAPH BY WINTON WEYDEMEYER

fringe of muddy bank or bottom, deserted by the shifting flow, lies uncovered. On those precarious margins a few marsh dwellers will winter through. I have just left the spot, and am still marveling at the sight of two Wilson snipe hurtling up from beside the swift, clear current. *Skaip! Skaip!* I might have known they would be there, but you never quite expect it. Their green marshes are frozen, their grassy meadow and sedge-grown retreats are brown and dead, and only white wastes now—but they are not gone.

When the snow melts back a little I will see them, jabbing and probing between the wet, gray boulders and the heaped-up slabs of river ice fringing the shore. This slightly warmer strip of the bank where the creek finds the river is their haven. But they are not confined to it. Two miles back in mixed conifer and broadleaf forest several springs and seepages melt the snow from mossy channels. On a day to come I shall almost tread upon a lone snipe as he crouches on the foot-wide margin. What a surprising winter picture—a bog bird circling in erratic flight amid the dripping January forest! The long-billed driller of the mud banks pitches skillfully from sight through the birches and firs. He may pass several days here while the thaw lasts. The snow denies him all but a few feet of boggy, black earth at the spring heads, and the narrow, shallow runnels that trace their short courses down the ravine. Yet on this meager hunting, on such slender defenses against the cold, he and a few of his hardy breed stay the winter out close to our northern border.

But listen! *Kill-deé, kill-deé, kill-deé.* How memory is jarred by the cry that so harried our ears on the beaches and mud flats last summer. It is not so shrill now, nor does the alarmist seek so persistently to make himself our unappreciated escort. Rather he avoids us and takes to wing, circling far out over the sullen, gray river. It is indeed that friendly nuisance, the town crier of the shore, the killdeer. Winter drove most of his clan to the south, but here by the tumbling creek's mouth he shares with Jack Snipe a frigid outpost in the northland. Only his presence could convince us that this narrow strip of sand, where tomorrow's stream may be flowing, provides anything beyond bleakness and hostility.

As we stand meditatively, gazing out over the snowy waste, there comes a rattling call from upstream. Once more a familiar note discloses a member of the hardy rearguard whom winter has failed to exile. And the

". . . through the spiraling flakes on bounding, roseate pinions, a flame-winged flicker flashes to a fir . . ."

flashing blue and white of a winged diver—hovering buoyantly, then plummeting into the riffles—reveals the year-round courage of the kingfisher, that belted and crested king of fishers. As we look, the snow almost vanishes before our eyes, and we have captured summer again. It is as though we are wading out toward midstream, looping a fly across to the farther ripples. The sun glints warmly, the willows bend and lave their silvery leaders. A trout tugs lustily at the lure, and with that rattling war cry from down the bend, the day and the dream are complete—if you are an out-

doorsman and not a mere taker of fish for the taking.

A winter's sun may be bright if not warm, the crisp air invigorating, and I plough on up the slope. Amidst the balsams winds the ever-interesting trail of a weasel. The tail-marked track visits the shelter of each snow-clad evergreen "teepee" along the way. One thinks intuitively of the velvety, white-footed or red-backed pine mouse that may have been hidden there; or the fierce and tiny shrew surprised at its own hunting; or the small bird close to the rough trunk with head under wing. Winter vastly multiplies the dangers of the wild.

As I toil on up the steep slope, among the higher yellow pines, several pine crows voice rasping, raucous *kar'r'r'rs* of greeting from the crowns of the conifers. The nutcracker is a born mountaineer. In descending thus far from his homeland of stunted spruce and alpine fir he is making a grudging concession to the season. Only rarely have I seen him in the valley. In his mountain parks

". . . a crested jay glides out and perches jauntily on the twisted bough of a snow-laden cedar."

PHOTOGRAPH BY THE AUTHOR

he may be observed secreting any promising edible that comes his way, tucking it into some crotch or crevice in the bark, and frequently capping his hidden store with lichen or moss. Doubtless he draws heavily upon these caches before he makes a first retreat to lower levels.

About me, on the rocky, buttressed mountainside, gnarled junipers crouch, clinging with uncertain root-hold to the jointed diorite. In the sparkling sunlight many-faceted snow crystals sift down. Then a crested jay glides out and perches jauntily on the twisted bough of a snow-laden cedar. In his iridescent uniform of deep blue, turquoise and black, capped by his high crest, the blue guardsman of the snowtime forests perfects this regal scene. A permanent resident, of course, yet he seems to have no visible means of support.

How does the jay maintain himself in this white domain, making the deep-walled valley his home? He owns no special adaptation of bill or claw; no single, certain food supply. Neither has he adjusted his diet so as to open some peculiar storehouse of the wilderness. He is certain of no insect store, into which, like the woodpeckers, he may pry at will. He cannot help himself to the hard-shelled nutlets that sustain

the grosbeak flocks. The food of dipper and duck are unknown to him. He must live by his wits.

The jay is the natural investigator of woodland events; by his own appointment he is inspector-general of the forest. There are so many things in this world that jays were put here to find out. Climbing, ladder-like, an evergreen, or atop some bare dead spire towering over the lesser timber, he keeps an alert eye cocked to detect anything amiss. Then the crested dandy publishes all that occurs with ready vocabulary, whether or not it is in need of an airing. A hawk-like scream, piped whistle or raven-harsh croak may be followed by another weird, less describable cry. In addition a versatile assortment of creaky noises and liquid gurgles escape him, apparently rendered in communication with himself. A crested jay usually leads the motley mob that escorts an unoffending saw-whet owl from the neighborhood, always rousing the trailing chorus whenever enthusiasm threatens to abate. In leisure hours the same blue-jacketed rascal may occupy himself with no more harmless diversion than pulling old birds' nests apart twig by twig. Pine seeds must be a dreary diet for so miscellaneous an appetite as the jay's, and he is apt to fare illy before the long hunger draws to an end.

On the morning after the storm I mounted to a high broken ridge. Near its summit a golden eagle swept over, bearing sharply toward the farther mountain. He broke his heavy, cleaving wing beat and lunged aside so that the rising crest of the ridge blocked further view. On what mission he could have been so powerfully bent, I might only speculate. Only a hunter gifted with such strength and keenness could sustain so great a frame in that hungry, white-blanketed world.

For the hiker in search of the rarer avians of these forbidding months, the valleyland proves more promising. Another sunrise, when the melodious, rolling notes of pine grosbeaks led to a fir clump by the river, I glimpsed a gray shadow vanishing into the cottonwoods and birches beyond. It faded quickly, ghost-like into the underwood, and I knew it for that most romantic of thrushes, the solitaire. No other thrush dwells so high among the peaks in summer; no other thrush winters as commonly with us. In the glistening snow-laden woods I have heard him give a single, bell-like note, wonderfully clear, wholly mysterious. Frozen wild fruit and juniper berries form the solitaire's sustenance now. It is likely that he requires little, being surely half spirit.

Again we follow the rime-frosted rim of the river. Who holds these cottonwood and alder fringes now? Where the valley broadens and the streams wander from the hills, the willows troop densely. Who keeps their ermine-trimmed thickets where in June that little masked charmer of the stream borders, the yellow-throat, held sway? They are kept safely, never doubt, but you must watch closely to find him in January. In spring you would know his notes unmistakably, although he improvises countless variations to the chorus. Yes, it is the song sparrow, a furtive, mouse-like being, with never a hint of the boldness that carries him to the tipmost branches in April. Until the magic of the wakening year fills his throbbing throat with melody, his tiny heart with simple sincerity, he hides in the streambank tangles.

Where fields rest beneath sheets of silver we catch a glint of black and gold. On thistle or weed stem, goldfinches sway as they garner a mite of seed whereby to defy the cold. Perhaps there is a shade less of abandon in their swinging flight; the ecstasy of their song waits for the high tide of the year. Yet their golden presence is sufficient promise, and they make a winter day incalculably more complete.

PHOTOGRAPH BY WINTON WEYDEMEYER

Today the snow is falling. The dull sky is obscured by numberless swirling flecks of white. I am prepared for the uneventfulness of an indoor day, when through the spiraling flakes on bounding, roseate pinions, a flame-winged flicker flashes to a fir on the drifted lawn. His high-voiced, bold *skeee-ak* pierces the hush of the mantled woodland. These visits are regular —as long as the small blue berries on the woodbine last. Afterward I hope to lure him to my feeding shelf.

A legion of his fellows departed southward in late autumn. This crescent-breasted champion bravely dares the uncertainty of the long northern eclipse. Yet unless the cold strikes sternly, with merciless thrust and unyielding grip, I question if he accepts my hospitality.

There is a vital lesson for us in his fortitude. As we look out upon the winter wastes, we seem to see only the peace and calm of death. But remembering the faith of our wild brothers, we may yet, deep within ourselves, find in them peace and saving calm for the heart.

Bubble Makes Page One

By EDNA and WILLIAM EVANS

Squirrel Paces Ledges
As Rescue Efforts Fail
By OGDEN SHARPNACK
Despite all-day efforts to rescue him, a trapped squirrel raced frantically through a vacant house yesterday at 3521 Fifth avenue north. Neighbors in the vicinity tried every measure they to free him, short of

NOT every squirrel can get her name in the paper for housebreaking, or pack a lifetime of adventure into ten days of not-much-desired freedom. Bubble did. She could doubtless best tell the story herself, but she has never mastered the typewriter. So we, who stood more or less on the sidelines, must tell it for her.

Bubble had never known what it means to be wild. Her mother was shot when Bubble was tiny, and five brothers and sister orphans were adopted by a friendly human and reared on a nursing bottle. Bub came to us when about half grown.

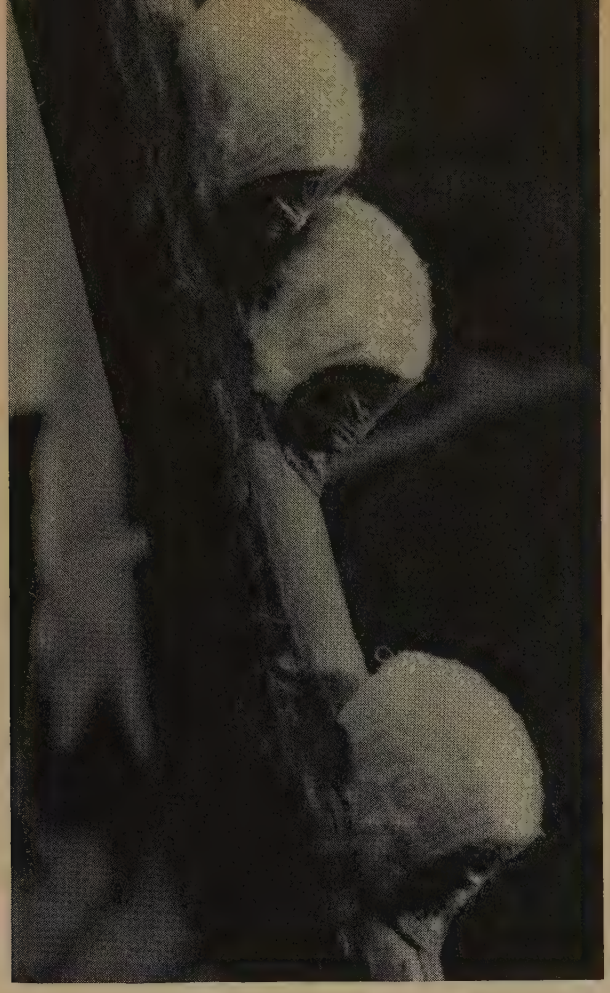
Tame, but frisky as only a young squirrel can be, she quickly adapted herself to our Florida household. She lived in a big, roomy cage on the glassed-in back porch, having a scamper about the living room almost every evening. She especially loved the cushions on the studio couch. Perched on them, she would sit on her hind legs and box with us. She never bit, and the few scratches we got were only accidental. She would even come down and touch noses with our Scottie, Snorky. A lifetime spent in our household menagerie has taught him that all our pets must be respected. Dogs, to Bubble, were nothing to fear.

Bubble's name has not always been Bubble. Because she was so impish as a youngster we named her Beelzebub—which was soon shortened to Bub. Later, as she won her way deeper into our hearts, she became, affectionately, Bubble.

During two years and a half Bubble grew fat, sleek, and tamer than ever. Often on Sunday mornings we allowed her to investigate the breakfast table. She was especially fond of butter. Somehow, we have never been able to think of our pets as "dirty." They eat the same food we do, and they are as clean as we, with their cooperation, can keep them.

The third summer of Bubble's life we went to Mexico. The relative who lived in our house during our absence was not fond of animals. The cage was banished to the back yard, and was there when we returned.

Before we had time to rearrange things and move Bubble back indoors, her cage door was left open and she disappeared. We scoured (Continued on page 550)



False Pussywillows

By EDWIN WAY TEALE

SOME midsummer day, weeks after the last spring pussywillow has disappeared, those who wander afield with a seeing eye may make a surprising discovery. On the twigs and branches of a maple tree they may observe what appear to be white, fluffy pussywillows—showing themselves out of season and growing on the wrong kind of tree. What the sharp-eyed observer has seen is a product not of the tree itself but of a strange, legless insect, the cottony maple scale. Its whole adult life is spent in one place. It is rooted almost as much as though it belonged to the vegetable instead of the animal kingdom. Its legs are lost when its final molt occurs. Thereafter the female scale insects appear as seen at the bottom of each of the "pussywillows"—a flat darkish object that enhances the resemblance of the mass of fluff to the real willow ament. The fluffy material is a waste product given off little by little by the scale, so the insect pussywillows on the maple tree appear to grow from day to day.

While this scale is found on quite a variety of plants, it thrives best on soft maple and to a less degree on hard maple, preferring twigs rather than leaves as a resting place. It is the most common and most injurious of the scales that infest our ornamental trees.

Chalk Age Nautilus

By CARROLL LANE FENTON

FROM our school days, at least, most of us recall Oliver Wendell Holmes's poem about the chambered nautilus. This mollusk builds a coiled shell lined with pearl, and with partitions of that material. As this shell becomes larger the creature slips forward, blocking off the useless space behind it with one of those partitions. These abandoned chambers hold gas that affords a certain degree of buoyance but not enough to permit the heavy, mud-plodding creature to rise to the surface, as the poets would have it.

The nautilus now lives near the Philippines and other islands in the southern Pacific. During the Chalk Age, however, several species inhabited shallow seas that spread across North America. When they died they became fossils such as this one, which was found in limestone near Fort Worth, Texas.

By using our imaginations a bit, we can picture this fossil as a living mollusk whose creamy shell had mottlings and streaks of brown. The body was pale pink, with dozens of slender tentacles, which were used to crawl, swim, and capture food. The creature also had two round eyes, and four special tentacles that were organs of smell.

The ancient nautilus probably ate dead fish, living crabs, and almost anything else it could get. Tentacles carried the food to its mouth, to be bitten into pieces by a hooked beak and shredded by a tongue that was far more rough than any steel rasp.

When the animal died, its shell slowly was filled by fine, limy mud. This mud hardened into limestone while the shell itself disappeared. Thus the fossil is only a cast, or solid filling, which shows the general shape of the nautilus shell and has deep grooves where pearly partitions once had divided it into chambers.

For the Orang

By ARTHUR H. FISHER

It was a gala day in the Primate House of the Zoological Society of Philadelphia when, some fifteen years ago, the first recorded birth in captivity of an orang-utan made front page news. Since that day, however, the Society has learned to take such an arrival in its stride, for only recently the fourth orang-utan was born in this oldest of American zoos. Furthermore, all of these offspring are alive and exhibited today.

It is a matter of opinion as to the relative I.Q.'s of gorillas, chimpanzees and orang-utans. Just as there are bright boys and girls and those less fortunate, so there are apes of varying aptitude in similar environment. It is obvious to any careful observer that during the later stages of adolescence and at maturity orangs show none of the uncertain outbursts of gorillas, or the erratic and spectacular conduct of chimpanzees. The chimp is a natural imitator and clown. Some possess a certain amount of guile, but usually they act on impulse. Orang-utans, on the other hand, are slow of movement, but in most instances apparently quite methodical in figuring out lines of conduct.

The orang is not an imitator of mankind, but does his own figuring. To keep them in captivity, every precaution must be taken in the construction of their cages. Nuts and bolts put on by Stillson wrenches come off by long and patient manipulation. An adult male orang in the Philadelphia zoo, after long, patient effort, bent and removed with his hands an iron cross-brace of a cage that a strong man would have found it difficult to destroy with a crowbar. Personally, after many years of careful observation, I cast my vote for the orang-utan as the most intelligent of all the apes.

Fringed Gentian

By EDWIN F. STEFFEK

The beautiful fringed gentian is in danger of extinction in many sections. It has long been prized for its beauty, its elusiveness, its rarity, and because it blooms late—long after most other flowers are gone. The beautiful blue flowers with curiously fringed edges close up when the sun is not shining.

This gentian was once found in low damp meadows and on moist hillsides from Quebec to the Dakotas, and south to Ohio, Iowa and Georgia. It is a biennial, so the flowers may appear here one year and somewhere else the next. The first year the plants make tiny rosettes and are found only with great difficulty even by experienced eyes. The plant seems to do best in a neutral or slightly alkaline soil, somewhat heavy. It must not dry out; it must have good drainage.

Contrary to the popular notion, the seeds are not harmed by frosts, and, although they may be stored safely in a cool dry place, they are best sown as soon as ripe. The soil for seeds should be a little lighter than that used for mature plants. While the seeds may be sown outdoors directly, the seedlings are so tiny that they are easily crowded out. So it is best to sow seeds in pots left out in a sheltered place until February or March. Then the pots can be taken in and kept moist. Seedlings should be transplanted while small.

"Victory gardens" come indoors for the winter and—

★

Desert plants find the window sill a winter home. On the opposite page a sill boasts begonia, philodendron, coleus, fern, and several other attractive plants. Photographs from J. Horace McFarland.

WHEN FROST nips the last of the Brussels sprouts and the vegetable bin is carefully filled with the season's crop, it is time to move the "Victory Garden" indoors. Although a window garden will not supply many vitamins, it will provide beauty and inspiration through the winter of waiting.

There is still plenty of time to start the indoor "garden". Anyone can grow house plants if they will follow a few simple directions, and a house or apartment in which at least a few of the hardier plants will not prosper is probably an unhealthy place for humans. Light is, of course, indispensable. Pure air and the proper temperature; a suitable growing medium; regular spraying; vigilance for insects and diseases are regular duties. Finally, grow only such plants as are suited to the available conditions.

Some plants demand direct sunlight, others can take it or leave it, while still others resent the sun. Geraniums must have sun to bloom, and even then are inclined to take a rest in winter. Begonias and ferns prefer indirect lighting or shade. Put the sun-lovers in a south window, if you have one. East is next best, then west, while north should be reserved for the ferns, begonias and others that are indifferent. Remember that winter days are shorter, often cloudy, and the sun's rays are more diffuse than in summer. Light strained through ordinary window glass is not intense, and the film that forms on glass from smoke and dust or cooking fumes reduces the sun's strength. Turn the pots around every week so that the plants will not grow unevenly.

Most plants relish a humidity of 60 or more, a condition that few houses offer even in the bath room or steamy kitchen. Any humidity that you can add to the house air will improve your health as well as that of your plants. It will help save fuel since a humid room always seems warmer than a dry one. Humidifiers, jars and pans of water, and the frequent spraying of the plants, all will increase the humidity. If the room gets too dry and stuffy, air it out occasionally, being careful to avoid direct draughts on the plants. Gas fumes will poison plants. Tough-skinned plants such as the cactuses, sansevieria and *Crassula* withstand a dry air better than those with thin, sensitive leaves such as the ferns.

Such plants as the African violet and gloxinia relish humidity but spraying causes yellow spots and mottling, especially if they are exposed to sunlight while wet. Even the normal desert dwellers bloom better if given good care. The Christmas or crab cactus and its kin, being subtropical natives, like a humid air but abhor wet feet, as do all plants in this group.

High temperatures harm more plants than are injured by coolness. Most plants like cool nights, and a temperature of from 50 to 60 degrees at night, with a daytime temperature that does not go about 72 degrees are best. The current fuel shortage will provide cooler rooms and a better environment for both plants and humans.

The soil in which indoor plants grow must be porous enough to permit the air to enter it freely. Formerly, porous pots were considered essential, but now a glazed pot is considered rather better for most house plants because it does not dry out as fast and is easier to clean. In case a glazed, glass, painted or metal pot or box is used, great care must be used to have the soil sandy and loose enough so that drainage is perfect and the air can get in. Never allow water to stand in the saucers under the pots more than a short time, except as noted later on. A good deal of sand in a potting soil is advisable—one-third sand, one-third loam, and one-third humus or peat moss being about right. However, almost any good garden loam can be used provided it is loose, friable and fertile.

It is always advisable to sift the soil with a coarse screen before potting, to remove trash, stones and such. Place a flat stone or a bit of pottery over the drainage hole and add an inch or two of gravel or

Window Sills Bloom

By ANDREW S. WING

Garden Editor of
Nature Magazine

washed cinders to assure drainage. Add a bit of soil and place the plant in the pot, filling in all around it with soil, being careful to tamp it well. Avoid burying the crown of the plant. If after a good soaking there is space for more soil, sift it in but leave an inch between the soil surface and the top of the pot for convenience in watering.

The pot should be no larger than is needed to accommodate the plant comfortably for one season. Too large a pot often encourages growth at the expense of bloom, while many plants—geraniums, for instance—will bloom better if slightly potbound. In the case of foliage plants, ivies, and others, this rule does not apply, the question of available space and convenience being primary considerations. Very often ferns, vines and other foliage plants are best handled in window boxes of metal or wood, flowering plants being added for color.

The current vogue for small succulents and ivies growing out of the backs of pink elephants and donkeys is more amusing than practical. Some of the plants will survive this treatment for a time, but few will thrive under such cramped and undrained conditions. Small pots, either glazed or porous, are quite suited for a collection of the smaller cactuses and other succulents, and a colorful display of these on glass shelves in a sunny window can be both decorative and interesting.

If you are fortunate enough to possess a shallow metal pan or box that will fit snugly into your window, you can fill it half full of pebbles and set your plants in it, thus saving a lot of time in watering and spraying, and also avoiding the danger of slopping water over on the woodwork. By keeping water in this pan all the time, but below the top of the pebbles, you will create a humid atmosphere around the plants without any danger of their roots being waterlogged.

Not so much has been heard recently about hydroponics, or chemical gardening, but certain phases of it are perfectly sound and practical for one who wishes to take the trouble to learn about it. Surrounding me in my glassed-in study, are a score or more plants growing in chemicals and sand. These plants are healthy, thriving, and many of them bloom the year around, with occasional rest times, for all flowering plants need occasional dormant periods. Geraniums, begonias, ivies, pothos vine, and aloes predominate. But there are also a Christmas cactus, a piggy-back plant, a century plant, two grapefruit trees, two avocados, crassula, and sweet basil. A number of cuttings are in the process of being rooted, some in plain water and others in pots of sand—a really better method. With the exception of the Christmas cactus, the piggy-back plant and the English ivies, all of these plants seem to relish sand culture, both indoors and on the porch.

The pots range in size from four inches to a foot, and there are two butter tubs filled with sand for the larger things. Most of the pots are unglazed and all have deep saucers so that a small amount of water may be left standing in them, a practice that works well with sand but not with soil. Some of the pots have wicks of glass wool to irrigate them from below, and there are two of the pots designed by Ernest Brundin, which have sand in the top compartment and solution below—an ideal method for small or medium-size plants, especially begonias. Rex begonias and geraniums seem to love sand culture and grow so tall that they must either be staked or cut back at frequent intervals. And how they do bloom! I should explain that this is really a plant room about 8 by 10 feet, having an abundance of light both winter and summer. The temperature runs rather high in summer, but there is ample ventilation and the nights are cool. In winter the temperature averages so cool that I move my office elsewhere except on very warm, sunny days. This coolness combined with a fair degree of humidity has, I am sure, much to do with the success I have

with these plants, which appreciate my care for them.

The chemical feeding is easy once you get used to it, and it is quite inexpensive. Since some of these pots of sand have been in use for three or four years, the coarse builders' sand has no doubt retained quite a lot of the chemicals that have passed through them, as well as a certain amount of organic matter from decaying rootlets. At any rate, I usually water the plants every day or so, depending on the weather, but I feed them only once or twice a week. Proper formulas may be obtained from various handbooks on chemiculture. Or you can use one of the advertised brands available at seed stores, florist shops and five and dime stores. These work all right for sand culture, but are naturally more expensive than if you mix your own.

The main thing with sand culture is never to let your plants dry out. Sand retains moisture quite as well as soil since there is not so much capillary action. After you get the hang of it you can experiment a bit, varying the formula, or even applying the elements in individual doses. This, however, is not recommended for beginners. Stick by the rules until you know the ropes. Chemical gardening is cleaner than growing plants in soil and just as easy, but it is not foolproof by any means. We are still considering sand not tank culture. The latter is also fascinating but much more ticklish to handle successfully.

Good care is essential with either sand or soil. More people fail because they do not water regularly than for any other reason. Plants consume a lot of water, especially indoors. Give them a good soaking as often as they need it, which may be every day in a dry room. Let the water run through the pot and pour off the surplus. Do not water again until the soil appears dry. Over-watering or drowning your plants is just as bad, although not quite so common. Never allow water to stand in saucers or jardinières, unless using sand culture and a porous pot.

A Saturday night shower bath is excellent routine for house plants. This is easily and quickly done with a fine mist sprayer. A bit of soap in the water will help subdue insects. Spraying removes dirt from choked pores. When the pots become encrusted with scale and algae, set them in the bath tub or kitchen sink and scrub them off with a stiff brush, wiping off the leaves at the same time. Your plants will reward you with clean, smiling faces for this sort of interest.

Nip insects and diseases before they get a start. Nicotine sulphate will control most of the common pests—the suckers such as white fly, aphids and mealy bug. Use arsenate or rotenone for the worms, beetles and other biters. Scale insects are tough and require an oil spray. Better cut out diseased portions, or those suspected. Discard promptly all plants that seem hopelessly diseased. Pick off all leaves that turn brown and prune out superfluous stems as you would a shrub. Browning of leaves may be a sign of maturity or a deficiency of plant food. Very often it is caused by insufficient watering. Watch your plants carefully and when in doubt consult your florist or a knowing neighbor.

A variety of little house plants add beauty and charm to the winter window.

Some window garden guests are transients and others are permanent guests. Both are worth while, though naturally the basis of a collection should be of hardy, long-lived varieties. The transients are nonetheless charming because their stay is brief.

Worth-while transients include begonias of the semi-tuberous types, calceolaria, cineraria, cyclamen, Jerusalem cherry, primroses and schizanthus. Buy these from your florist. The bulbs such as narcissus and hyacinths you can force yourself.

Fall-blooming permanents include *Begonia semperflorens* (everbloomers) and the rex type; geraniums, *Pelargonium*, in many lovely new shades; bush chrysanthemums; African violet or *Saintpaulia*.

Winter bloomers include poinsettia, fuchsia, moraea or winter iris, nutmeg geranium, and several of the primroses.

Spring bloomers are *Astilbe*, bleeding heart (forced), hydrangea, Martha Washington geranium, azaleas and pansies (winter in cold frame).

Good foliage plants are Chinese evergreen, *Aspidistra* or "cast-iron plant", rex begonias, *Coleus* in variety, *Dracaena*, crassula and several ferns.

Excellent trailers or climbers are asparagus fern, Kenilworth ivy, creeping fig, English ivy (likes shade), sweet potato (suspend in water), *Philodendron* and wandering Jew.

Many people will, of necessity, be spending much more time at home this winter than in peace time. They will find great pleasure in developing a hobby of caring for indoor plants. It is an activity that is full of rewards and has by-products that many other hobbies lack.

This is the twenty-second in Nature Magazine's series of educational inserts

BLACK WIDOW SPIDER (ABOVE), HOUSE SPIDER (BELOW) AND THE GARDEN SPIDER

Along Came a Spider

By E. LAURENCE PALMER

Illustrations by Velma Knox and MacGeyger

MRS. MUFFET made a great mistake when she let her daughter be frightened by the spider that came to sit beside her. Mrs. John Citizen compounds the mistake when she repeats the nursery jingle which has prejudiced so many against some of the most interesting and usually harmless creatures in our neighborhoods. Of course, the black widow spider is dangerous, but it is not aggressive; and, of course, some of the related animals like the mites and the chiggers are offensive neighbors. But the mill-run of spiders that run about our homes, swing from our trees, sail through the air, dive through the water or hide in holes in the ground, are harmless and often valuable members of the fauna of our back yards and gardens.

When Liberty Hyde Bailey was asked what should be done about dandelions, he is reported to have said that we should learn to love them. Similar advice might bear on our attitude towards spiders, because there is little doubt that we will have to live with them indefinitely. Their oldest ancestors were probably marine, but ever since Silurian, or late Ordovician times there have been spiders running around on dry ground, or at least their ancestors have been doing this. The earliest true spider fossils are found in the Carboniferous Age, as is also the case with the earliest of the closely related daddy-longlegs.

I have lived or spent substantial periods of time in homes in the four corners of the United States. In each place, I have found spiders similar to those that haunt my permanent home. In fact, the common house spider is one of the most widely distributed of the spiders, apparently able to adjust itself to highly varied conditions. If you look in your attic or cellar you will probably find one on its web protecting one or more of its egg cocoons. While looking for a house spider, you may find a loose web with a slender-bodied spider which jumps about on the web at times as though it were an insane acrobat. This squint-eye spider might be mistaken for a daddy-longlegs if we did not know that the latter does not build or live on a web.

It is fun to explore your own home for spiders. We have a colony of mud-dauber wasps at one end of our home. Occasionally, the wasps get in our sleeping porch to the distress of the family. But I enjoy watching the wasps and my spiders. We might assume that, in a contest between a wasp and a spider, the spider always loses. We are told how the wasp paralyzes the spider and stores it away in its nest as food for the wasp grub. In my attic, below a maze of spider webs, the remains of plenty of wasps are scattered on the floor.

TRAP-DOOR SPIDER AND TARANTULA

It is difficult to know how to feel about these contests. Most of the family do not like the spider webs, and so do not like the spiders. But people who do not like spiders also despise flies, mosquitoes and moths. Although you can show the spider webs strewn with the remains of

WATER SPIDER, WOLF SPIDER, TURRET SPIDER

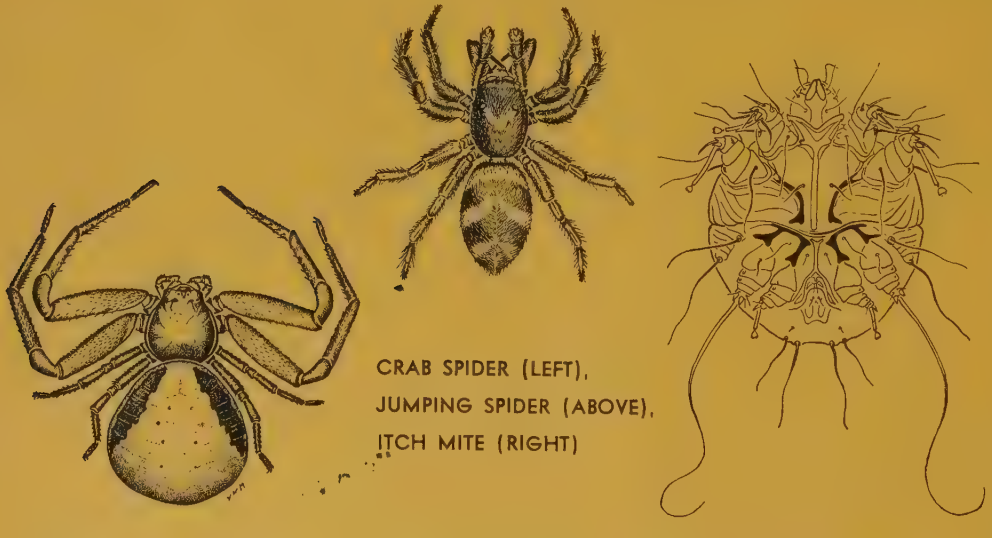
these insects, the spiders are not popular. And so when a wasp comes along and steals a spider from my attic how should I feel about it?

One of the things that annoy our household is the presence of slender threads of cobweb that hang vertically from the ceiling or from the lighting fixtures. Sometimes, these are draped gracefully across corners and sometimes they get well covered with dust before they are discovered. Rarely, if ever, are there any spiders on these webs, and the question has been raised as to how the webs got there and what made them.

Of course, it is not safe to say that all webs that hang from a ceiling are made by one kind of spider, because they are not. Some of them, however, are made by little spiders that I have known and recognized since I was a youngster and before I had any formal training in Nature. I believe the first one I ever remember seeing was on the porch rail at my grandfather's home. I remember seeing this little gray spider run erratically on the sunny side of the rail. I remember trying to crush it with my finger and failing because the spider suddenly jumped to a new position. When I tried again, the spider again escaped by jumping. This provided me with so much fun that I devoted some time not to trying to kill the spiders but to seeing how far I could make them jump. I remember that I noticed that some of these jumping spiders had huge jaws, but it was years before I learned that this enabled the males to hold the female during the mating act.

It is these jumping spiders that we can see on the window casings of our homes. They often lie in wait along the molding, on a picture wire, or on a hanging fixture. When a supper goes flying by, they launch themselves into the air and capture it on the wing. Instead of being borne away by their supper, they merely cease to let out their line of silk and crawl up it with their prey to eat the captured creature at their leisure. The silk, being of no more use, continues to hang from the ceiling gathering dust until it is discovered by some irate housewife.

All the interesting spiders on my home lot are not found in the house. My garden, my lawn, the woods, the pool and even the driveway have spiders of their own. Probably the most beautiful of these is the orange garden spider, which builds large webs in a vertical plane between some of the plants of my garden, or even at the edge of the woods in the trees. I like to follow this spider and its behavior through the year. There is a little clump of weeds that I have saved in my back yard. Each year I can find in it a few silken cocoons about the size of a hickory nut. In these cocoons, the young spiders hatch in the middle of the winter and remain within the cocoon, living by eating each other and gradually growing until such a time as they are ready to free themselves. These spiders are likely to build new webs frequently. So large and elaborate are some of these that we are likely to wonder how they are able to produce enough silk to do the job.



CRAB SPIDER (LEFT), JUMPING SPIDER (ABOVE), ITCH MITE (RIGHT)

What makes me marvel at these spiders is how they escape capture when they rest exposed in the open air so far from any shelter. They have the ability to drop to the ground suddenly in case of real danger, but this must expose them to other enemies on the ground. The webs are particularly interesting. I can hardly resist poking each one I see with a blade of grass to see what happens. The lines that extend like spokes of a wheel are not sticky and I can easily draw the grass away from them after they have been touched. The lines that make up the spiral *are*

sticky. Once they have been touched, I have difficulty in drawing the grass blade away without destroying the web. It is easy enough to draw conclusions as to why these two kinds of silk are used in the web. This becomes more significant when we notice that the spider runs about the web on the spoke threads rather than on the spirals. I also like the little stabilizer ladders that are so often to be found on these webs. They look much like a shoelace and are used to tighten up the web or release the strain, depending on weather and other conditions that might destroy the web if provision was not made for them. Nature anticipates many needs.

TRIANGLE SPIDER, GRASS SPIDER, BALLOON SPIDER

So strong are the webs of these garden spiders that they are able to catch and hold a large grasshopper that may spring into it with considerable force. Of course, the webs may break and be repaired but it is remarkable that they withstand as much as they do.

Another favorite spider of mine is the funnel-web spider whose webs I find in the grass at the edges of my lawn. As the season advances, these webs grow larger and larger, as does the spider builder. These webs are much more permanent than those of the garden spider, which commonly builds a new web each night.

The funnel webs are often overlooked unless they get covered with dust or dew, when they stand out as gray patches in the green. Usually they are supported at the corners by more substantial grass blades, the tops of which may be high above the ground. Between the tops, one or more "trip threads" are frequently found. These serve to upset an insect flying above the web beneath. By the time the insects have regained their equilibrium, they may have fallen to the web below. What happens to them there is the business of the spider.

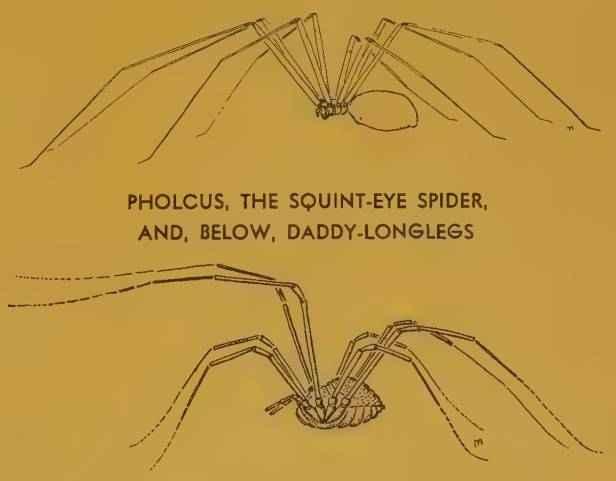
CHIGGER

CHICKEN MITE

The male funnel-web spider rarely builds a web as large as those of a female; in fact, he rarely stays at home long enough to build a big web. He is off on courting expeditions, visiting the webs of females who are just as likely to eat him for a meal as to accept him as a suitor. Unless she is disturbed, the female may spend her entire adult life on the one web on which she lives. These spiders are unique among many of the commoner spiders in that they run about on top of their webs instead of suspending themselves from beneath them.

Down among the grasses and out on my bare driveway run a host of long-legged active spiders. Frequently, they go dashing across a bare concrete sidewalk. I once watched one of these spiders stage a fight on a sidewalk with a large wasp. The contest lasted for fully a quarter of an hour, with the wasp keeping the spider from getting to the border cover and yet hesitating to break through the threatening guard the spider was putting up. A number of times they went into a rough and tumble clinch only to break loose and back off for another try. Finally, the spider collapsed, and after I had chased the wasp away I found the wasp egg laid on the spider.

These spiders which are so common on the ground in my yard are for the most part wolf spiders. They build no web; few if any dig any burrows. Instead they seek shelter in the vegetation or under rubbish. In such a hiding place, they lie in wait for a lunch that may pass by. When the time is ripe, they dash out and catch their meal and that is about all there is to it. They waste no time in making elaborate webs or digging underground shelters. They see what they want and they get it. Their abundance and wide distribution indicate that there is merit in their technique for living.



PHOLCUS, THE SQUINT-EYE SPIDER, AND, BELOW, DADDY-LONGLEGS

The flowers of my garden serve as hosts for one group of spiders that always delight me. I remember the first one I ever saw. It was in the throat of a white trillium flower that I had plucked to lay on top of a basketful of brook trout I was taking home to my mother. I thought that the flower looked peculiar but I was not prepared to see a pink and white crab spider (Continued on page 536)

COMMON NAME SCIENTIFIC NAME ORDER FAMILY	HOUSE SPIDER *Theridion tepidariorum* Araneae Theridiidae	SQUINT-EYED SPIDER *Pholcus phalangiodies* Araneae Pholcidae	GRASS SPIDER *Agelena naevia* Araneae Agelenidae	ORANGE GARDEN SPIDER *Argiope aurantia* Araneae Argiopidae
DESCRIPTION	Female, with body ¼ inch long; male, with more slender, ⅛ inch body. Legs, nearly 3 times the length of the body in front. Exceedingly variable, but bearing several dark chevrons above the end of the abdomen and on the under side. General appearance, dirty and dusty.	Body, about ¼ inch long, and longest legs just over 2 inches long. Body, conspicuously long, slender, pale brown in color for a spider. Might easily be confused with Daddy-long-legs, but for presence of a web and the general body characters that make it a true spider.	Medium-sized spider, varying in size and color, but with 2 longitudinal black lines bordering gray lines on the back. Male, ½ inch or less long; female, up to ¾ inch long. Legs do not vary greatly in length. Median gray band down the back serves as quick, rough identification character.	Large black and yellow spider. Male, about ¼ inch long; female, about an inch long, with front legs as long as the body. Colored conspicuously, with the rear of the body black, with bright orange or yellow spots that make a band along the sides.
RANGE AND HABITAT	Over 300 species of the genus have been described, about 40 of which are found in North America. *T. tepidariorum* is the most common of the species. Commonly found in and about houses, particularly in dark, unused places, as under porches, in attics, and the like.	Closely related to house spider though not in same family. American species of genus, 2; related American genera, 6. Common in cellars, under porches, in houses, both in Europe and in America. Closely related species found limited for most part to Florida region. Favors dark, warm places.	Four species of the genus found in the United States, the genus also being represented elsewhere in world. Commonly found on or near their webs in grass, on lawns or in meadows, and most conspicuous when webs are covered with dust or dew. Probably one of most universally common spiders.	Rather closely related to the Silk Spiders, from whose silk cloth has been made. Appears in literature as *Miranda* frequently. About 120 American species known. Favors marshes, gardens or among tall plants protected from the wind. Webs sometimes found on shrubs.
REPRODUCTION	Male courts female; may be eaten if unwelcome or after mating. Eggs, 50 to 200, laid in spherical cocoons hung in webs 6 to 8 weeks after mating, hatch in 1 week. In next 8 weeks, young pass through 5 moults, feeding on each other; leave cocoon in second stage and web of parent in third. Nine cocoons may be made in one season.	Eggs, laid in inconspicuous egg-sac which the female carries about with her rather than leave it hanging in web, as is case with house spider. Egg-sac, thin, seen only when it is looked for carefully. Young develop in egg-sac and when released live for a while on mother's web.	Lives but one year, winter being spent in egg stage. Adults die soon after eggs are laid. Eggs in irregularly shaped, flat sacs, under rubbish and usually protected by female until her death. Male wanders in late summer visiting webs of females, seeking mating, but may be eaten for his trouble.	Male and female build similar nests but male visits female's nest in fall. After mating, female lays eggs in cocoon size of hickory nut which is firmly fastened to vegetation. Eggs hatch in midwinter but young remain in cocoon until May. Mature by midsummer and disappear by October.
HABITS AND FOOD	One mating fertilizes eggs for many cocoons. At first, young feed on each other, then on scraps in mother's web. Finally, leave to make own webs. Webs, irregular. Adults may or may not have place in which to hide and await prey. Fourth pair of legs has a comb of fine teeth which help fling silk on prey.	Builds a large, irregular web which is loose and open. On the web, spider hangs head down, except when alarmed. When prey enters the web, spider jumps around on web shaking it violently and entangling victim which is then killed. Food, almost exclusively small insects caught on the web.	May stay on one web all summer if undisturbed, the web being enlarged with the season. Trip thread common between supports above the web. Spider runs on top of web, unlike most species and hides in funnel, which has a rear entrance for escape or for pouncing on prey. Webs of young plain by May.	Remarkable web, sometimes 10 feet across, with ladder-like structure near center, and shelter web where adult hides. May add secondary web near center. Can kill large grasshoppers that land in web by enmeshing in silk and then biting. If frightened, drops to ground and hides in vegetation. Web remarkably strong.
RELATION TO MAN	Ability to adapt itself to varied climates has made species almost world wide. Useful as destroyer of house insects such as flies, moths, mosquitoes. Webs collect dust. Should be studied living in every biology class in preference to so much book teaching.	Useful as a destroyer of insects and interesting because of its behavior on loosely hung web. Of course, it clutters up neglected places with its webs, but this does no great harm, and insects captured can not do harm they might do otherwise. Lives comfortably in a dark box if fed.	Useful as destroyer of insects that may be injurious to crops. A most excellent subject for study in fall biology because of abundance, food-getting habits, the physics of the nest, sensitivity, locomotion, and protection. May be attacked by parasitic wasps. Webs used by some birds in nest making.	Probably useful as insect destroyer. The physics of the web is worth studying. New web usually made each night. Not all portions of the web are sticky as may be discovered easily. Spider commonly parasitized by ichneumon flies which may themselves be parasitized.

WOLF SPIDER *Lycosa helluo* Araneae Lycosidae	TURRET SPIDER *Geolycosa arenicola* Araneae Lycosidae	WATER SPIDER *Dolomedes urinator* Araneae Pisauridae	CRAB SPIDER *Misumenia vatia* Araneae Thomisiidae	JUMPING SPIDER *Salticus scenicus* Araneae Salticidae
Medium-sized spiders. Male, about ½ inch long; female, ¾ inch long. Color, gray, yellow, grayish brown or brown, with a yellow, narrow middle stripe down the back. Legs, shorter and stouter than those of the water spider. *Dolomedes,* although some species of *Lycosa* have relatively slender legs.	About ⅞ inch long, with stout body and strong legs. Male, more slender than the female. Color, reddish brown, obscured by gray hairs, with a broad light band down the back which becomes narrower towards the abdomen. The body is hung low and the female's abdomen is conspicuously larger than that of the male.	Large, long-legged spider, the sexes differing so greatly that they have been described as separate species. Male, with conspicuous, yellow band around forepart of body; female, with large abdomen bearing median, yellow band, with 3 to 6 pairs of small yellow or white spots. Relatively active, with remarkable locomotion abilities.	Medium sized spider, with front legs spreading 3 times the body length. Male, ⅛ to ⅙ inch long; female, ⅛ to ½ inch long. Color, yellow or white depending upon the flower on which it lives, usually with pink markings or red markings. Male, usually darker, particularly on sides.	Relatively small spider. Female, slightly larger than male, reaching length of ¼ inch. Male, conspicuous, even to naked eye, because of larger mandibles of jaws which hold the female in the mating. Gray, mottled, hairy, with numerous white bands and spots. General appearance, flat or low. Front eyes touch each other.
In same general group with water spiders and turret spiders, a group that includes a majority of the larger spiders which run on the ground without making nests. Commonly found on or under stones or in holes underground, and when pursued, runs rapidly, even going upon or under water to escape many enemies.	In the same general group with the wolf spider, which it resembles slightly. There are roughly 114 species in America in the family Lycosidae, all of which live on or near the ground. This species digs burrows underground, the entrance being marked by little turrets of sand.	One of a rather large family of nursery-web spiders. By some, they are grouped with the wolf spiders, the Lycosidae, but in *Dolomedes* the upper row of eyes is less curved and is smaller. *Dolomedes* is commonly found on, under, or near water, and because of skill in diving, is sometimes called the Diving Dolomedes.	A dozen species are distributed through United States, a number being from far West. Commonly found on flowers or resting in throat of some bell-shaped flower. In spring, seems to favor white flowers; in the fall, yellow; may change from white to yellow in 10 or 11 days. Not common in winter.	Only common species in the United States but this one widely distributed even into Europe. Three species not so common. Found on walls of rooms, on window casings, on fences, barns, wooden houses commonly where it is sunny or where wood has been weathered. Not offensive in spite of its abundance.
Eggs laid in spherical sacs, each consisting of 2 pieces. Sacs carried by female to rear of body. Female frees young from sac and they may crawl over her body taking a ride with her wherever she goes. The young soon leave the parent and shift for themselves. The female builds a silk-lined nest for shelter in early summer.	In late May, male courts female; is eaten by her usually, after mating. In June, female retires to burrow, closes it, spins and protects cherry-pit sized cocoon containing eggs. Young emerge from cocoon in July, live on mother's back, moult twice by August, leave to dig own burrow. Mature size, third fall; sexually mature next spring.	Eggs laid in an egg-sac almost equal in size to that of the abdomen of the female, may number to 300. Young freed by mother when sac becomes mottled; may be guarded in web nursery, or in web under stones. Young feed on each other at first; not fed by mother. Web made just as young are freed from sac.	Eggs are placed by female in flattened silken sac which is composed of 2 equal parts. Female protects sac and young, the sac being usually fastened to some leaf or other plant part, and hidden on some incurled surface. Young feed on each other until they leave the sac to shift for selves.	Male courts female by dancing before her, spreading his legs out at the sides and up over his back and head. Eggs, laid in cocoons, often several in a single nest; laid early in season, hatch early. Young guarded by mother until able to be independent, or well through summer, when young leave mother's nest for independence.
Food, small animals, mostly insects caught by pursuit. May be active during the day, but most active at night when its food is more active and its enemies, such as many wasps, are less active. A fight between a wolf spider and a wasp, which uses the spider as a food supply for its young, is well worth watching.	Preys on small animals caught by pursuit. First year, burrows few inches deep; second year, 10 inches or more; mature spider burrows to 18 inches, often ending in enlarged cell in which winter is spent. Entrance turret may be reinforced with plant material. May go months without food, without ill effects.	Feeds on water insects and other small animals caught largely by pursuit. Normally wary; hides under water or vegetation skillfully. Webs built apparently only for protection of young. A ¾ inch spider has been known to capture and drag from the water a fish 3½ inches long weighing 4 times as much as the spider.	Makes no web but lies in wait usually in throat of flower to capture insect visitor, then hangs on with hind legs while the forelegs are used in capturing the prey even though this means a struggle, when the prey is larger than the spider itself. Most active in warmer, sunny seasons.	Although this spider spins silk, it makes no web for capturing prey. It moves rapidly, in any direction and when necessary, leaps into the air to capture its prey, "letting out a line" of silk until it is ready to stop, then climbs back up the silk to the place left. Hides in silken nests in winter.
Probably of considerable importance in controlling insect enemies of plants of fields and gardens and most difficult to conceive of as harmful to man's interests. Makes an excellent and interesting terrarium pet for home, camp or school, and should be better known than it is.	Useful enemy of insects that may injure plants. Worth studying because of great sensitivity to jar, light, odor, sound and moisture. Can be frightened by footsteps 12 feet from burrow entrance. Will come to entrance if beam of light is centered on the entrance. Rushes to entrance of burrow at slightest disturbance.	Possibly serves some role in maintaining a balance among small animals of waterways. Most interesting because of ability to swim under water, to build and use rafts from which to dash after prey, and because of webs which so obviously serve as a nursery. Harmless and should be studied more.	Possibly useful as insect destroyer but always interesting as garden or terrarium pet. May wander from flower to flower but if hiding places are limited, the spider may usually be found easily. One may stay for days in a single flower if undisturbed.	Amusing and harmless resident of the rooms in which most of us live. Obviously, it favors dryness, sunny spots and warmth, and is active in daytime rather than at night. Makes excellent subject for classroom study and should be better known than it is by all students and housewives. It makes common cobwebs which hang from ceilings.

COMMON NAME SCIENTIFIC NAME ORDER FAMILY	BALLOON SPIDER *Erigone autumnalis* Araneae Micryphantidae	TRIANGLE SPIDER *Hyptiotes cavatus* Araneae Uloboridae	BLACK WIDOW *Latrodectus mactans* Araneae Theridiidae	TARANTULA *Eurypelma hentzii* Araneae Avicularidae
DESCRIPTION	Body, about 1/20 inch long, and easily recognized by generally light color, and the bright yellow head. Male has claspers used in holding female in mating. Related species are mostly larger and darker in color. Legs, moderately long, and movement, relatively slow. Does not frighten easily.	Male, 1/12 inch long; female, 1/8 inch long. Generally inconspicuous, but none the less interesting. Back of female, with 4 hair-bearing humps which in male are less conspicuous. At rest, spider closely resembles a tree bud, for which it is commonly mistaken until it moves on being disturbed.	Black spider, with body 1/2 inch long; legs, slender; abdomen, large and almost spherical, with an hour-glass-shaped, red spot on under side. Front and hind legs, longer and more slender than the middle pair. Female, over twice size of the male, whose body is under 1/4 inch long.	Largest of American spiders, some species measuring 2 inches in length of body alone, with legs correspondingly large. Body and legs, conspicuously velvety. Legs, stout, but able to carry spider rapidly. One South American tarantula has legs which spread over 7 inches; another has a body 3 1/2 inches long.
RANGE AND HABITAT	About 95 species of the family and 30 of the genus. There are 4 American genera. Found for the most part on the ground, in grass, among leaves, moss and other small plants, where they spin their small webs during the summer months. In the fall, they are found high on some post or exposed plant.	One species is best known in United States but there undoubtedly are others as yet undiscovered; possibly, present on west coast, in closely related form. Found on dead twigs commonly in gorges and similar places where air may be relatively quiet. Usually, on a twig next web.	From New Hampshire to Patagonia and West to the Pacific coast, but more common in southern and western United States. Favors damp, dark areas such as are found in cellars, under boards, in stone walls and frequently in outhouses. Closely related to harmless house spider.	Closely related to trapdoor spiders; about 40 species in family but does not belong to the same family as the Italian spiders whose behavior gave the name "Tarantella" to a dance. Lives on or near the ground hiding in holes under stones and in logs and debris. Common in the southwestern United States.
REPRODUCTION	Little known of the life history. One member of the family builds a dome web about 3 inches across; others build small webs like plain sheets. Some favor houses; others fields, and others woodlands, but all are most commonly inconspicuous and the webs are usually noticed only when dew-covered.	Egg-sacs, not easily noticed as they are placed on twig and resemble bark or silk. They are oval and flat and have an outer covering over 1/4 inch sac. Covering is gray like bark, or dirty white due to fact that portions are made of black silk mixed with white. Young hatch in brood sac.	In June or July, female makes 3 or 4 1/2-inch cocoons, each of which may contain about 300 eggs. Young hatch, feed on each other. In a few weeks, survivors emerge from cocoons and begin eating spiders, insects and other small animals. May mature and breed by fall and females may live through winter.	Mates in fall. Following summer, a female puts 300 to 600 eggs in a thick-walled cocoon which she protects. Young grow slowly first half year, rapidly next 4 or 5 years, moulting about twice a year, and living sometimes as long as 16 years. Only 2 or 3 may mature out of an initial 5,000 young.
HABITS AND FOOD	About time first frosts appear, great numbers of erigonids climb to elevations. There they spin long streamers of web when air is rising, which serve as balloons with which they may journey great distances. Sometimes streamers cover a field causing the "gossamer", "flying summer" or "old woman's summer" effects.	Makes a triangular web of 4 threads with cross threads, one corner terminating in a single, long thread. Spider takes up slack on this long thread, and when prey enters web, releases it to snap the web and tangle prey in meshes. Spider rests feet uppermost beneath this trip-cord, slack lying loosely between front and hind feet.	Not ferocious, and normally must be forced to bite. Bite causes serious discomfort and while 10 percent of those bitten have been reported to die, there is no record of death occurring to a healthy adult human. Pain is general, not accompanied by great local swelling, causes slight temperature, lasts 3 days.	Not poisonous in spite of contrary convictions. Bites painful, but not serious because jaws suitable for crushing its food of insects. Some species can kill birds. When annoyed, assumes defense attitude. Can hear camera click. Bites only when forced to do so. Largely nocturnal. Common prey a wasp, tarantula hawk.
RELATION TO MAN	So conspicuous are the gossamer threads, when dew or frost covered, that everyone has noticed them in their season. The little spiders probably do some good in controlling small insects which might be enemies of useful plants.	May be kept in a small bottle where it may build its web, lay its eggs and if food is available live with reasonable comfort. Too small for general appreciation but included here because of unique method of capturing prey and because of remarkable resemblance to its immediate environment. Protective coloration almost perfect.	Entitled to worst reputation enjoyed by any spider. Use ligature, cut wound, apply weak ammonia and carbonate of potash. Since bite tends to paralyze bowels, cathartics are used also. Name "black widow" probably from habit of female eating the male but this is a common habit in other spiders.	Valuable as insect destroyer and of no serious injury to man's interests, so really worthy of protection. Relies on sense of touch. Probably, cannot see difference between light and darkness but seems to be "charmed" by bright light at night. Makes excellent terrarium pet and thrives if given reasonable care.

TRAP-DOOR SPIDER *Cteniza (Bothriocyrtum) californica* Araneae Ctenizinae	DADDY-LONGLEGS *Leiobunum vittatum* Opiliones Phalangiidae	ITCH MITE *Sarcoptes scabiei* Acarina Sarcoptidae	CHICKEN MITE *Dermanyssus gallinae* Acarina Gamasidae	CHIGGER *Trombicula irritans* Acarina Trombidiidae
Large spider. Body of adult female, 1⅛ inches long. Legs, long and stout. Color, whole spider, rich, dark chocolate brown with legs slightly darker. Third claw better developed than in tarantulas, having rake for digging which is absent in web-building tarantulas and needed here for hole digging.	Spider-like, with body ⅕ inch long, and 8 legs varying in length from 1 to 2 inches; the second pair longest. Body, brown; legs, black. Male, smaller bodied and more brilliantly colored than the female. Abdomen, segmented unlike the spiders. Abdomen, with stink glands which are effective.	Almost too small to be seen by the naked eye. The mite is white. In the female, the first 2 pairs of legs end in stalked suckers; in the male, all 4 pairs have suckers. The fourth pair in the female is long-bristle tipped. Size of mite, about 1/50 inch long and 1/75 inch wide.	Flat, reddish, pear-shaped mite, about 1/35 inch long and slightly more than half as wide with hind legs not reaching to the rear end of the body. Female, with long piercing mouth parts; male, with pincer-like mouth parts. Body, not conspicuously constricted at any place. Young have 3 pairs of legs, as in insects.	Minute harvest mite that has a greater restriction forward of the middle of the body than most others of the group. Immature form has but 5 hairs on the dorsal plate. In the immature and pestiferous stage, it is small enough to make its way through the meshes in ordinary cloth used in clothing.
A half dozen American genera of trap-door spiders, some with several species and closely related to the tarantulas. Fairly common throughout the southern and western United States but more common farther south. Lives almost wholly on or under the ground, in burrows which may be six inches or more deep.	One of 16 American species; about 15 American genera, with 2 families, with about 60 American species in all. Found in fields and meadows, or sometimes crowded in considerable numbers in holes in logs or in brush piles, but usually close to ground and most commonly more or less solitary.	Closely related to organisms which cause such skin diseases as scab and mange. About 100 known species in group, of which 13 are American. This species, parasitic on man and hogs. Common where cleanliness is not observed, with the female laying her eggs under the skin of the host.	One American species of the genus, but 18 American genera in the family. This genus is found almost exclusively on birds, though this species may live at least temporarily on humans, dogs, cats, horses or other domestic animals. The relationship is of course parasite on a host.	Closely related to "red spiders." About 4 American genera and 30 species, in none of which are the adults parasitic. This species occurs from New York to Minnesota and Kansas and through the South, but close relatives extend the ranges, particularly westward in the South. Found on vegetation and then on animals.
Life history habits in general similar to those outlined for the tarantulas. Young remain in the nest burrow of the mother with her for about 8 months leaving the home burrow after the winter rains cease and establishing burrows of their own. New layer of web added to door each year. May live 7 years or more.	Eggs, laid in fall through a long ovipositor which is thrust underground or in debris; hatch in spring. Young, white, with black eyes at first but otherwise much like the adults whose color they soon develop. By fall, young have matured; then mate, lay eggs and most individuals die, wintering being as eggs.	Female makes irregular burrows under the skin, laying egg-shaped eggs singly in rows of about 22 to 24. Eggs hatch in about 7 days into little mites whose explorations cause further irritation. Time from eggs to egg, about 4 weeks, though cold weather may extend this period considerably. May live away from host.	Elliptical, pearly white eggs are laid from 3 to 7 at a time, with a total of 25 to 35 laid during eight periods. Eggs laid in cracks near roosts, or in nests, hatch in 2 days into small mites, which, after the third moult, become adult. Time from egg to egg may be 7 days; individuals may live 4 months.	In northern part of range, larvae appear in June and disappear by October. They attach themselves to animal hosts which brush against plants on which they lie in wait. They do not burrow under the skin, but attach themselves and cause intense itching and pink or red spots. Usually leave host in 1 to 7 days.
Food, largely insects and other small invertebrates that can be captured with quick forays from the nest. Life dominated by fear particularly of parasitic wasp enemies, of which there are many. Highly sensitive to jar and to light. Does not leave nest; can hold cover shut from beneath.	Food, small insects and other small animals as well as dead and decaying matter. More or less nocturnal, though active on bright, sunny days. Builds no web or nest. Moves about slowly, getting some protection from noxious odor. May shed legs to effect escape; these may serve as a poor barrier protecting body.	Position under the skin makes it practically impossible to remove pests mechanically, and attempts to do so only spread the infection. Others may be infected by contact with clothing, towels, bed clothing or anything handled by infected person. No significance in the "seven year itch" idea as infection need not be tolerated.	Crawls about roosts and birds sucking blood, most commonly at night and hides easily because of smallness, flatness and other qualities. In the family are some mites that live independent of hosts, some which are parasitic on insects, as well as on warm-blooded animals; and some that use insects primarily for transportation.	Known to live as parasites in larval stage on man, mice, rats, rabbits, prairie chickens, quail, toads, box turtles and snakes. Humans attacked severely may run a slight temperature, and develop certain nervous diseases due to inability to sleep. Japanese chigger causes Japanese river fever fatal to 33% of victims.
Useful as destroyer of insects and similar animals captured at burrow entrance while door is held open by abdomen of spider. Some tunnels have two doors; some, branched, but all, lined with water-proofed silk. Some are camouflaged at entrance. Excellent terrarium and garden pet which is harmless.	Interesting to children who have been told that if held they will point in the direction the cows are to be found. Since they point in all directions this is a reasonably safe generalization if one successful prediction is considered adequate. General role probably that of a scavenger, but of little economic importance.	Infected person should be bathed and rubbed thoroughly in hot water and green soap, followed by bath in hot water and by applications of sulphur ointments which should remain on body several hours. Infections should not be tolerated particularly where persons come in contact with others in schools, churches and buses.	May be kept in control by scrupulous cleaning of roosts and nests, by use of crude petroleum mixed with kerosene. If too abundant, may kill chickens or so weaken them as to injure their productivity. May kill young of wild birds that use same nest succeeding seasons.	Controlled by soaking garment in ¼ pound of naphtha soap and ¼ pound of powdered sulphur in a gallon of hot water. Garments should be tied to hinder entrance of the chiggers. Cure with sulphur or carbolic salve. A great pest, attacking man and beasts as do the chiggers of Europe.

(Continued from page 531) resting where I had come to expect to see only stamens and pistils. These spiders, like the wolf spiders, make no webs. Unlike the wolf spiders, they do not go out and run down their prey. Instead, they rest in a likely place and catch it. Their forelegs are modified so that they can catch an insect much as the jaws of a steel trap close on a victim. The rear of their bodies can be thrust into and held in the throat of the flower so that the struggling insect cannot drag the spider loose in its attempt to escape.

The most remarkable thing about these crab spiders is their ability to change color. At some times, they are white with pink spots; at other times, almost entirely yellow. When they are on a white flower, they are white; but when they rest on a flower like goldenrod, they so nearly match the color that even you are not likely to notice them.

The tree tops support a host of spiders, but my favorite is a little fellow that one finds in the gorges near my home. Usually, it is on the dead top of a hemlock, but this is not always the case. It looks so much like a bud on a twig that it would rarely be noticed were it not for its triangular web. This web is discussed in the chart section.

Few people who have haunted fresh-water brooks and pools have failed to see a rather husky spider that runs rapidly off over the top of the water or dives at will beneath the surface. Fewer may have noticed the nursery-like web which these spiders build in the top of some weeds near the water. This web is not used in capturing prey but solely as a protection for the young spiders as long as necessary. Like their relatives the wolf spiders, these water spiders get their prey by running it down. Their ability in getting a meal either in the open air, on the surface of the water, or under it is, of course, unique.

The spiders have plenty of kin with varying reputations. The daddy-longlegs are experimented with by most youngsters at about the time in life when attempts are made to make threadworms from horsehairs. It is strange that once having overcome one's aversion for spider-like things by handling daddy-longlegs more people do not get better acquainted with spiders.

If we consider the mites as kin of the spiders and think about chiggers, the itch mites and chicken mites, we realize that these are animals whose intimacies we do not welcome. Chiggers are troublesome enough in their season but they are not so persistent as the itch organisms once they have become established.

It is difficult to classify spiders and their kin in our minds. Zoologically it is simple. Emotionally we feel we should consider them ogres. Poetically we turn to the delicate tracery of the webs. Economically we are in a quandary. We may turn to good books for our answers. *The Spider Book* by Comstock is one of the best. James Emerton's *The Common Spiders of the United States* has helped me improve my appreciation of the spiders about my home.

It is, of course, ridiculous to let the appearance of some of these animals prejudice us. To a fly or a grasshopper, they may be ogres but why to us?

"Where webs are spread to more than common size,
And half-starved spiders fed on half-starved flies."

In these lines one poet uses size of the webs and the hunger of spider and fly to show that the place has long been free from the disturbances of a housewife.

Another writer must have watched his spiders, because when he wished to emphasize a delicate touch he wrote:

"The spider's touch, how exquisitely fine!
Feels at each thread and lives along the line."

Of course, Shakespeare provides a wealth of appropriate similes such as Queen Mab's coach, the wheels of which had "long spinners' legs" for spokes, while the traces that drew it were "of the smallest spider's web". This sentiment is much nicer than in the verse in which the spider asks the fly to walk into its parlor with inhospitable intent. Of course, we have been told that it is bad luck to kill a spider, but that seems to hold little force in face of the Miss Muffet experience.

There have been attempts to use spider silk commercially, and silk cloth has been made from the silk of certain spiders. The effort required to produce this silk was such that there is little likelihood that it will become the basis of a big industry. Rayon and other substitutes for silk have undoubtedly closed the door to seeking silk from spiders, except for delicate instruments.

The silk of spiders, however, is something that holds the interest of those who like to understand what is going on in Nature just for the knowing. Not all silk from spiders is alike, and some produce a number of kinds of silk in the construction of different parts of their webs. Spiders use silk in ballooning their way across country in the fall, resulting in the sheets of gossamer we see so frequently spread over the fields in fall. Once you have watched a spider produce one of these streamers you have had an experience that you like to share with others. It has no commercial value. It will not affect your health. But it is fun to know about it and that sort of thing is what is meat to the naturalist. For this reason, spiders merit study.

The psychologists have been interested in spiders to help them in the study of instinct and intelligence. They find that most if not all of the actions of spiders are orderly responses to definite stimuli. They find that some spiders act after a definite pattern when an insect gets into their webs. They may, like the house spider, follow a pattern where the procedure is something like the following. The spider dashes across the web to its prey. It reverses its position on the web when the prey is reached. It wraps a thread of silk about the prey and gives it a pull. If the web is again shaken by the struggling victim the procedure is repeated. It may or may not bite at the end of each trip, but this is the pattern that is followed whether the web is disturbed by a luscious fly or by the end of a wire in your hand. These orderly series of behaviors following stimuli which can be easily typed are just what the experimental psychologists like to work with. Fortunately the behaviors are not always orderly in all species so there is little likelihood that those who want to know what a spider will do under all circumstances will be able to find the answer in any book. This is one of the nicest things about spider study—about all Nature.

As We See It

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Hunting and Patriotism

"HUNTING is a patriotic duty" is a slogan that has been gaining currency in sporting circles. It is a rallying call that has enough truth in it to be dangerous doctrine if applied indiscriminately to all the forms of wildlife that are classed as game.

There are definite indications that, nationally, at least, there will be a decrease in hunting. This decrease will probably be progressive while the war continues. It will come about because of the diversion of so many men into the armed forces and their transportation to far places in search of other targets. It will unquestionably be influenced by national gasoline rationing and the gradual wearing out of pleasure car tires. If the war goes on too long even sporting ammunition may be exhausted.

Assuming that hunting will fall off, there will be an increase in game animals. While this would appear, on the surface, highly desirable, it also has its undesirable aspects. Less shooting can well benefit our migratory game birds, our supplies of upland small game and some other species of game animals that are now too few for the habitat available to support them. On the other hand some forms of wildlife face the prospect, in some areas, of suffering rather than benefiting from less hunting.

We have, in particular sections of certain states, what game administrators describe as "problem areas". These are places in which the big game population—in nearly all cases deer and elk—have increased up to or beyond the carrying capacity of the habitat. In other words, there is not enough food to support them during the winter. Starvation and its companion, disease, then take a greater toll than the gun. In such problem areas hunting has to be stepped up even in normal times, and in case of war-reduced shooting means must be found to avert such local disasters.

Pennsylvania, Michigan, Colorado, Wyoming, Wisconsin, Utah, California, Washington, Oregon and New Mexico are among the states that have such problem areas. In the West, in particular, the great distances involved will cut down the hunting. Many of the National Forests have considerable areas that, as a result of protection, and the elimination of predators, are getting overcrowded with big game population. Hunting regulations must be adjusted to control such conditions and hunters must be available. Even the most ardent sentimentalist must recognize that quick death from the gun is preferable to slow starvation. There are, sad to say, people in Europe today who would choose the former way out.

Deer and elk create the "problem" in most areas, although black bears and antelope are potential problems. Some small game animals, in some quarters, might, with a sharp falling off in hunting, increase sufficiently to create difficulties for themselves or for the agriculturist. Man has so complicated the conditions surrounding wildlife that, except in large areas where human disturbance has been at a minimum, it is difficult or unwise to depend upon Nature's restoring her balance. Game control by hunting, based upon the facts of the particular situation, must be invoked.

In view of these local needs for hunting, the slogan with which we began these comments might not seem dangerous doctrine. It *is*, however, by virtue of its generality. If it is interpreted by the thoughtless hunter—and they are far too numerous—as a call to get out and shoot indiscriminately it is dangerous. If it is taken as an invitation to pay none too scrupulous attention to the game laws—and it may by some be so interpreted—it is dangerous. If it gives the impression that all game birds and animals have increased to a point where seasons should be lengthened and bag limits increased, then it has done serious damage. These are not only possible but probable results of promoting a slogan among the many who ignorantly, thoughtlessly or indifferently go afield with guns.

Wise hunting, which provides a means for keeping some species from increasing too much, and allows others to continue their comeback, or keep from going farther toward extinction, is necessary. And, in these times, it should be careful hunting, so that no pound of meat should be wasted. Our game birds and mammals should not be sought commercially to feed the nation, but those that are shot for sport should be carefully husbanded to supplement the home supply.

Nature in Print

By HOWARD ZAHNISER

NATURE has meant so much to Americans that it has found its way into all the types of literature that we have created—whether essay, poetry, narrative, exposition, fact or fiction; whether for information, inspiration, or entertainment. The thirty-two volumes that make up the 1942 library reviewed on this page from month to month are in themselves an ample demonstration of this fact, repeating in a twelve-month period the variety of our past literature and giving assurance that Nature is still as much alive in our literature as in our world.

Nor is this year of book benefits without an appropriate close with the four volumes that are now at hand. First of all, for the children, Fay Inchfawn has written a fantasy entitled *Who Goes to the Wood.* One might wish, while enjoying the fictitious handling of such characters as "Duck," "Mouse," "Reddy Fox," and "Whatever-It-Was," that the fantasy might have been more in keeping with the wild prototypes, for Mouse riding on Duck's back to visit with a friendly "Aunt Shrew" is indeed fantastic. Yet there runs through the book a narrative of a captured wild cat which gives meaning, and in an excellent final chapter Fay Inchfawn does create a fine fantasy in her tale of the flood-time rampage of "River." The illustrations by Diana Thorne are excellent, of course, and the quotation "Who Goes to the Wood Goes to His Mother" is in itself worth something.

Carroll Lane Fenton and Mildred Adams Fenton, in another recent volume called *Mountains,* have written not only for older children and young folks but also for any reader who may be setting out for the mountains, or wishing to do so. This book, the publishers point out, "brings to light every phase of the engrossing history of mountain building in America —a history that goes further to embrace all that is life in the hills. Over these mountains roam the moose, bear, and porcupine, and in the streams swim the famous rainbow trout. Here, too, is the saga of tree and plant development." Photographs and drawings by the authors and two kodachromes by John Kabel make *Mountains* a fine volume to possess, and its final chapter on "What to See and Where to Find It" very tempting indeed and quite promising.

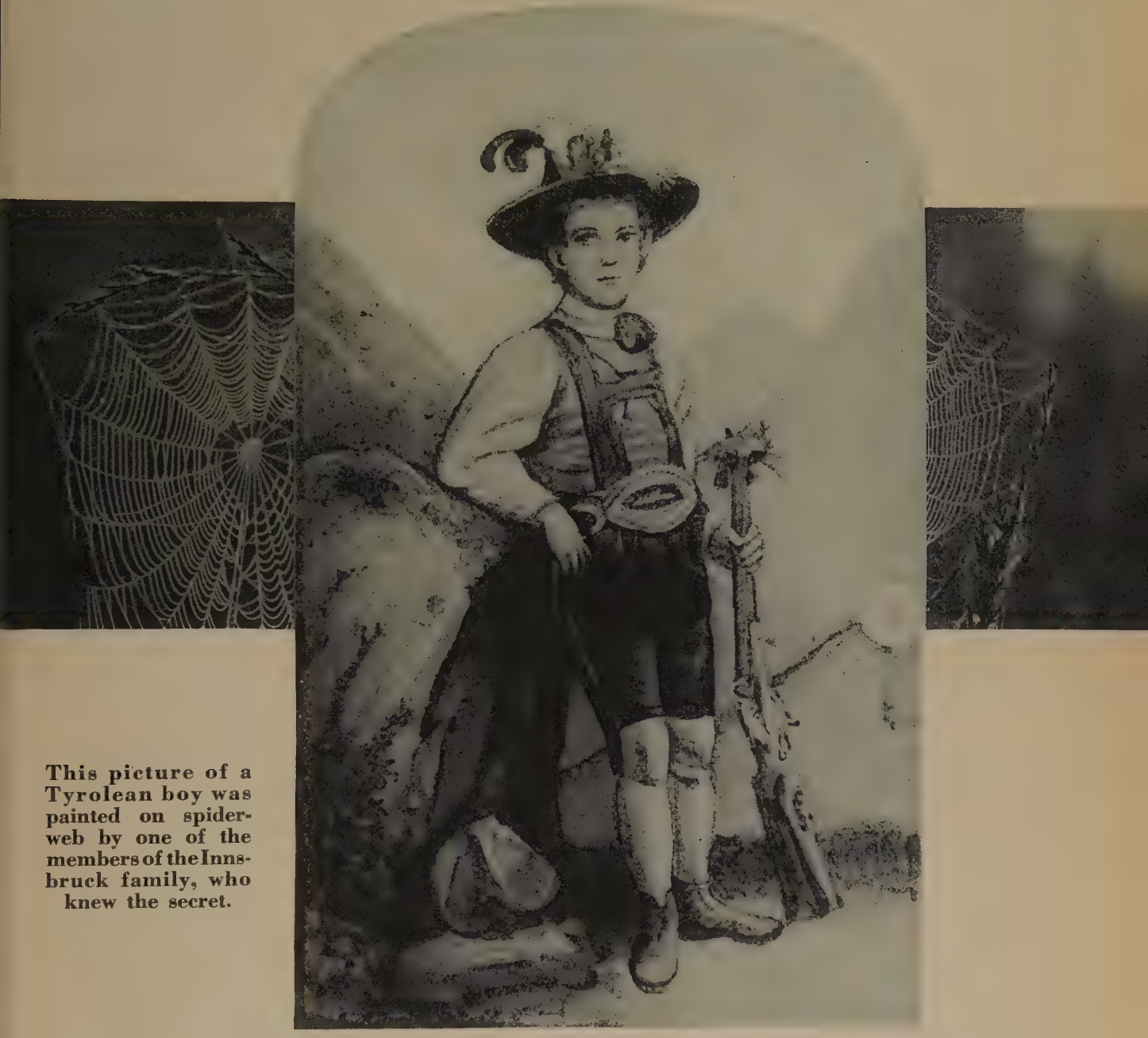
It is hardly probable, however, that any visitor can come to know mountains as well as William Marshall Rush knows the Rockies. His *Wild Animals of the Rockies: Adventures of a Forest Ranger,* described by the publisher as "authentic tales of the wild," is based on three decades of first-hand experience during a time when, as he says, he was "paid to do the things that many men would gladly pay to do." Based also on a gift for tale-telling in a good Western manner and an awareness of the needs of conservation, Bill Rush's book is a valued combination of entertainment, instruction, and enlightenment—an adventure book that is at the same time the testimony of an expert and eye witness who knows what has been happening to American big game, and why. He writes of bears, elk, moose, deer, antelope, buffalo, mountain sheep, and mountain goats, making a reader as envious of Bill Rush for his experiences as he is thankful for the book that relates them. Sixteen pages of photographs illustrate many of the scenes that are familiar to Bill Rush and that other Americans can either preserve or lose—depending on the strength of their determination to conserve.

Certainly those who will read *Fading Trails: The Story of Endangered American Wildlife* should have both a strong and a well-informed determination to see these trails again so well-worn that they may be apparent to any Americans in the future who seek them out. *Fading Trails* is one of the most important and timely works on American wildlife that has ever been published. It is a case-history book of wildlife conservation. It points to the diminishing numbers of green turtles and recommends "prohibit fishing for them for 15 to 20 years or more." It discusses the California condor and places "the problem squarely in the laps of conservationists and other people of California." It tells what has happened to the animal Stanley P. Young calls the prince of predators, and concludes: "Is it blasphemy to suggest that more research and less bias is needed in the case of the mountain lion?" Thus the authors, calling the roll of more than two dozen kinds of threatened wild creatures, make their diagnoses and indicate the treatment.

Prepared by a committee, (Continued on page 550)

Spider-Web Painting—A Lost Art

By ETHEL HINCKLEY HAUSMAN



This picture of a Tyrolean boy was painted on spider-web by one of the members of the Innsbruck family, who knew the secret.

Artists of the sixteenth, seventeenth and eighteenth centuries were fond of painting on unusual and bizarre materials such as horn, mica, glass, birch bark, various fungi, shells, as well as upon such fabrics as silk and velvet. But the most astonishing of these materials were the extremely delicate webs of certain spiders, which were spread upon frames, and painted by a technique known to very few.

My interest in these unique paintings was first aroused when I saw in Chester Cathedral, England, a beautifully clear transparency of The Madonna and Child. The picture, measuring about six by nine inches, hangs in the Lady Chapel at Chester, and beneath it one may read: "Madonna and Child painted on fabric made from spiders' webs, known only to an Innsbruck family, and now a lost art." Not long ago I became the possessor of one of these inimitable Innsbruck transparencies, a picture of a Tyrolean boy, wearing a flower-and-feather-bedecked hat, and holding an antique gun also decorated with flowers. High Alps are shown in the background. A painting

almost identical with mine is in the Lenox Collection of the New York City Public Library, the gift of Robert L. Stuart. Another, also the gift of Mr. Stuart, is in the Library of the Bureau of Entomology in Washington, D. C. Recent inquiries have brought to light a few more of these paintings on spider webs, the subjects being principally women.

In 1906 a friend traveling in Innsbruck purchased several paintings on webs from one Franz Unterberger. Two of these were oval portraits, one of a flaxen-haired peasant girl, and the other a portrait of Philippina Welser, the Bavarian commoner who later became a marchioness. Another friend owns an oval portrait, said to be the artist's sweetheart, "Anna".

Such paintings were, in an earlier day, frequently purchased by tourists in Innsbruck. One traveller tells me that when he was in Innsbruck in 1930, he visited the little shop of Herr Franz Unterberger, and there was shown the last of these famous paintings, seven in number. Herr Unterberger declared that these were the last that would ever be done in this technique, for the old artist who had executed them had passed away, carrying with him the secret of their preparation. We trust that with his delicately developed technique his spirit is now painting, with sunset colors, upon the clouds of his Long Home!

The Innsbruck transparencies—usually measuring about two by three inches, rarely larger—were mounted between frames of heavy cardboard, and sold in heavy folders, to which was usually attached a bit of the web. Web painting flourished in the Puster Valley, South Tyrol (now in Italy) during the middle of the eighteenth century, where it was fostered by Elias Prunner and his pupil, Johann Burgmann of St. Georgen near Brunek, both of whom painted on spider webs, and also on webs from caterpillar nests. Examples of Burgmann's art may be seen in the Museum Ferdinandeum at Innsbruck. Among the last of the paintings purchased from Herr Unterberger in Innsbruck were some bearing the signature, "Defregger". This may have been Franz von Defregger of Stronach (1835-1921). In the Museum Ferdinandeum also there are to be found paintings of a much earlier period than Defregger's, also executed on spider webs, and apparently intended as votive pictures.

Among the earliest known examples of spider web paintings is one, "about the size of the palm of a small hand", depicting a drinking bout, and thought to have been painted about 1530. It is recorded to be in the possession of a Czechoslovakian art lover, Count Czorin. Another, a harbor scene, was the work of Andrea Selari del Gebbo, painted about 1532. Many years ago Chaplain Bragato, of the Austrian Court, found in Rome a miniature of Leonardo da Vinci's "The Last Supper," rendered on a spider web.

The Innsbruck paintings in the various collections throughout the world are all executed in brilliantly clear colors, with firm line and great clarity and precision of detail, and the workmanship of the subjects is almost equally satisfying on both sides of the web.

What few modern web paintings I have seen seem to have been executed with a technique appreciably different from that of the Innsbruck masters. The webs, also, are of a looser weave, and do not so much resemble fabrics as do the webs from Innsbruck.

So very carefully did the early web painters guard their precious secret, that today little or nothing is known about the spiders, their webs, the pigments used in the painting, or their manner of application. As far as can be determined, there is nothing in the literature of either arachnology or art touching upon the subject, nor could the larger museums of art, the museums of science, or the arachnologists of this country and abroad with whom I have corresponded throw much light upon the matter. Rumor says that the spiders were originally brought to the Tyrol from South America, where in some secret locality they were fed and bred, and their webs produced. It may be that the Tyrolean artists anaesthetized their spiders, during the production of the silk for the webs, for scientists who had worked with spiders had early discovered that when the creatures were artificially inducted into a semi-torpid state, their secretion of silk from the spinnerets was greatly accelerated.

One American and one Swiss authority in the field of arachnology believe that the "painting-web" spiders may be some species belonging to the family *Agelenidae*—the funnel-web weavers. To this family belongs our common grass spider, which makes the white webs on the grass, called by some "fairy washings". These webs may be so numerous on lawns and over fields on dewy mornings as to produce the effect of an almost continuous sheet of glistening silken gossamer. Or the webs may be those of the cosmopolitan house spider, those indefatigable weavers of the so-called "cobwebs", found commonly in houses, outbuildings and barns everywhere. As both of these spiders run about over their webs, they spin a drag-line behind them, which, being constantly added to the web, so increases its thickness that after several months the web becomes a dense tough sheet. To other authorities the thick character of the web suggests that it may have been the product of one of the tube or tunnel-making species, as for example, the American purse-web spider, or the funnel-web tarantula, whose cloth-like cylindrical webs, when split and opened out, make fair-sized pieces of fabric. It may be that, for greater strength, several webs were superimposed. Possibly they were treated with some secret preparation for the better reception of the pigments, or for the preservation of the web itself. It is remarkable to note that some of these paintings have endured, apparently without deterioration, for upwards of 400 years!

Several experimenters in the early eighteenth century, endeavoring to find a substitute for oriental silk, cleansed and carded spider egg "cocoons" and from them obtained threads, fine as gossamer, and yet resistant enough to be woven (Continued on page 550)

A friendly little animal that looks like a miniature bear, and makes a fine pet, is—

The Syrian Hamster

Photographs by Ernest P. Walker

By MAVIS McLELLAN

In 1930, near Aleppo, Syria, a litter of hamsters was found in a burrow twelve feet underground. Today the descendents of this family have founded large colonies in Great Britain, Canada, and the United States. Yet, so little known is this small immigrant from Bible Land, that dictionaries refer only to a larger and less attractive cousin, the European hamster.

The Syrian hamster, *Mesocricetus auratus,* is a friendly little animal, slightly smaller than a guinea pig, with golden brown fur and a very short tail. Standing up tall, with small white forepaws poised to pluck a clover blossom from your hand, it resembles a little bear. Amazingly, the blossom, stalk, and leaves will all disappear inside two internal cheek pouches, until the "mini-bear" appears to have a bad case of mumps.

Firm believers in the carry and cache plan, female hamsters love to hoard. One of my own pet hamsters would tuck away a yard and a half of blue rick-rack braid in one pouch alone. Then away she would trot to unload it in some favorite corner of the cage, while I still held one end of the braid.

Two other hamsters—Stuff and Nonsense—liked to be offered fluffy tufts of cotton batting. Piece after piece they would gather, cramming them in tighter and tighter until their pouches bulged back half the length of their bodies. Then, with saddlebags loaded, they would look around with funny faces for a place to disgorge. Squirming, gagging, and wriggling, at last they would push it all out with their forepaws. This feat never failed to amuse and alarm our friends, somewhat shocked to see live animals stuffed with cotton.

One day Stuff was placed on the bed of a convalescing child, who was well covered with a fuzzy woolen blanket. "Look!" someone cried. And there sat Stuff, busily packing her pouches with wool. After that, I always watched her carefully when she rested on my sweater sleeve. Usually, she was only stopping to wash her face. This important procedure, often repeated, is accomplished by a brisk, criss-cross motion of the forepaws. Curiously, a hamster never forgets to scrub behind both ears at once.

On starry Syrian nights, hamsters pop out of their burrows in search of grain and grass. They probably sleep by day. In captivity, they are always alert when awakened, whatever the hour may be. They have a strong homing instinct. My young son, who kept his own hamster in a galvanized tub in the basement, took his pet to the attic playroom. A few floor boards were lacking under the eaves, and the hamster disappeared between the rafters. That evening scratching sounds were heard in the dining room wall. The next night—silence. In the morning, the boy happened to take a rueful glance at the empty tub in the basement. Hungrily, two eyes reproached him. The lost hamster had found its way home.

Eventually, this odd little creature may become as common as the guinea pig, for it is extremely prolific. Henry Bergman, of Springfield, Missouri, increased his original number of hamsters seventeen times during the first six months. Now he keeps them, like hens, by the battery system. When he opens the doors of a twelve-family unit, as many as twelve adults and 107

young may crane out their heads, like people from skyscraper windows.

Hamsters mature in four months; have a short gestation period of sixteen days; and produce litters of three to twelve. Calf meal, Purina Chow Checkers, and greens provide an adequate diet. Because they have no diseases of their own, are cleaner, more prolific, and eat less than guinea pigs, hamsters are now being raised as laboratory animals. In time, some may escape to the fields, and become a part of our wildlife.

Clean, odorless, and alert, they are interesting pets. Naturally inquisitive, they will readily enter an empty tin can, and thus may be transferred about. Or you may encourage them, when young, to climb out on your hand. Although a pet hamster is not likely to bite, it does not care to be grabbed. But even strangers can seldom resist stroking its soft, thick fur.

Clean, odorless, alert and inquisitive, the little Syrian hamster is an interesting pet.

Raising a litter is well worth attempting. The reproductive cycle in the female occurs about every nine days. At other times she will fight the male, who lives alone and likes it. Slightly larger than he, and neater in appearance, the female is a prettier pet, and provides the chief source of amusement—the young.

Our first baby hamster, an only child, was so fat at two weeks his tummy would trip him as he waddled over a rootlet. Helplessly waving his legs, he would lie on his back a few seconds, before rolling right-side-up again. Then off he would wobble in search of an oat flake to carry back to his nest to chew.

Once we hit the jack pot with a litter of seventeen. Squirming in the cup-like nest of peat moss, these embryonic bits of new-born pink feebly waved sixty-eight small feet and defied us to count them. Several times we counted each blind head that tapered to a tail no bigger than a pencil point, as though to convince ourselves we really could add. Seventeen! It seemed impossible.

Within a week this litter was reduced to six, three of each sex. One of the few instances of cannibalism noted in our colony, it was perhaps a wise old instinct of Nature to reduce too large a family.

A few days after birth, the blind baby hamsters crawl over each other, and out of the nest, if shallow. Soon the mother grasps them by their tiny tails, and pulls them in again. Later, she may return them to the nest as a cat carries kittens. A hopeless task, indeed, for they instantly run out again.

Opening their eyes between the second and third week, they scamper about with exaggerated vigor, behaving like little adults. Furiously, they wash their faces, and fill their pouches with grass. Presented with a carrot, they push each other aside with brief protesting squeaks, each trying to find the best place to nibble. If there is nothing else to do, they wrestle. Over and over they roll, like boys on the lawn, until one bounces away, or burrows himself beneath the body of a sleeping brother.

A nestful of hamsters curled together, some sleeping on their backs with feet in the air and soft white underfur exposed, is a study in complete relaxation and comfort. Contented too, is the mother, grunting sow-like in her sleep as the young ones suckle.

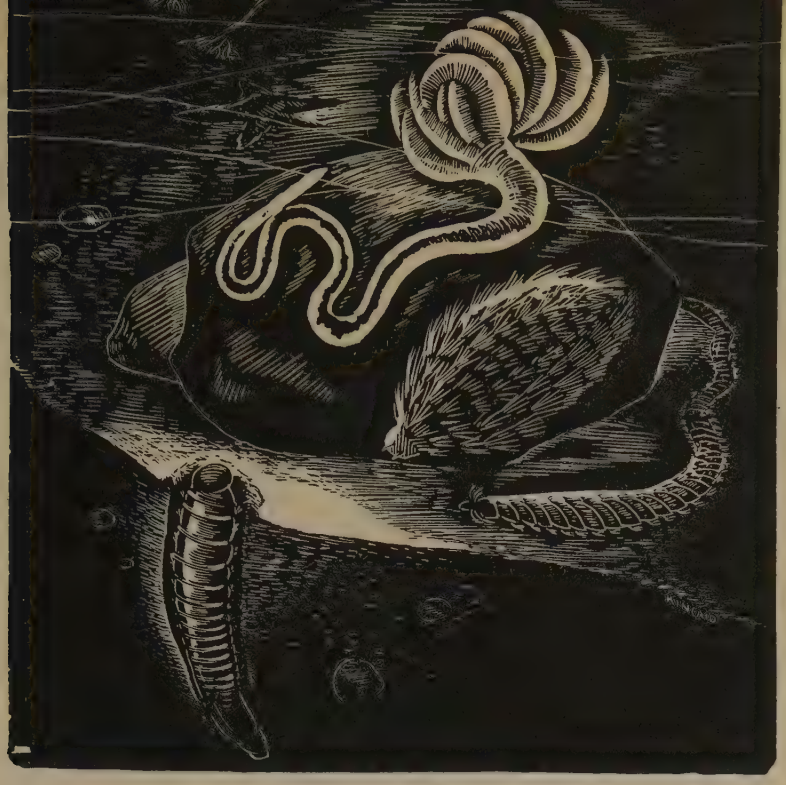
Far from their friends, the gerbils and pouched marmosets, Syrian hamsters are dwelling among us. Happy in captivity, they offer pleasure in learning their habits.

★

Full Moon

By MAREL BROWN

We watched the moon
  Until it climbed to the top of heaven.
We watched the moon
While our hearts skipped beats to an old, old tune.
  Its silver light the perfect leaven—
  What matter that we must rise at seven—
We watched the moon!



Marine Worms Use Bomb Shelters

By MURIEL LEWIN GUBERLET

WHEN WAR stalks the earth with terrible and unforeseen consequences, and when man is attacked from the skies, on the sea, on land, and by fifth columnists within his gates, the first business of life becomes self preservation—the sheer, stark task of survival. To meet this, man resorts to measures that in normal times seem humiliating and undignified. To a people accustomed to walking with heads high in a beautiful and secure world the necessity for hiding behind blacked-out windows and crouching in underground shelters is almost inconceivable.

Although this is a new experience for civilized man, there are animals that because of ceaseless and unremitting dangers have been forced for eons to seek similar refuge and to live in bomb-proof shelters.

Almost all animals exist in a highly competitive world, but perhaps those of the seashore are beset with more dangers than any other group. They must adapt themselves to the unceasing ebb and flow of the tides, the daily exposure to sun and drying, the equally regular plunge into icy waters, the constant threat of storms and famines, and last, but not least, to the relentless wars that are fought and refought with their neighbors. A larger animal is always waiting to devour a smaller, weaker one—*ad infinitum*.

In order to survive, each group of animals faces and solves these problems in a different manner. The result is that seashore animals have worked out habits and life histories as strange and as fascinating as fairy tales. They show remarkable ingenuity in their adjustment to the demands of life.

In the process of adapting themselves the majority of seashore animals have acquired weapons of defense or offense. These take the form of thick shells, suits of armor, long sharp spines, many legs, powerful fins, poison gas, or clever wits. The worms, however, failed to develop any of these means of protection.

Most of the worms are fat and soft and naked, and are utterly unprepared to meet the strife and clamor of the seashore. The only salvation of these hapless creatures is the ability to burrow into the sand and to fashion shelters above ground. With this meager equipment each species has worked out its problem in a unique manner.

The lug worm, for example, secretes himself in a long tubular house extending eighteen or more inches into the earth. To the world the only evidence of this dwelling is a circular ring of sand—an inch or more in diameter—at the mouth of the burrow. And strange as it may seem the lug worm builds his house by eating it. The sand that he removes while digging the burrow passes through his body, where the organic matter is assimilated and the inorganic matter is deposited as waste at the entrance of the burrow. Here it serves as a sand-bag barricade.

The ribbon worm is even more cautious. He gives

no clues to his hiding place. In the construction of his house this retiring fellow uses a pick-like tool called a proboscis. When at work on his underground shelter he holds the proboscis straight out in front of him, and, as he forces himself forward, the proboscis acts as a steam shovel and pushes away the sand. Some such tool is absolutely necessary to the ribbon worm because his body is very soft. While digging, the worm contracts to a third of his real length. This is convenient for it relieves the necessity of digging a long burrow. He expands to his full length only on the rare occasions when he ascends to the beach.

The collared tube worm has the chimney of his house above ground. He makes a chitinous tunnel that reaches far down into the sand, but the chimney reveals the location of his abode. The worm spends most of his life in the dark depths, but when he is hungry he moves to the top of the tube, opens a trap-door on the chimney and thrusts out two stout tentacles. These move back and forth and extract food materials from the water. When his hunger is appeased the worm closes the door and returns to the bottom of the tube and rests until the next meal. It is a dull life but a safe one.

The lime tube worm is braver than his underground relatives. He lives in a strong limestone house that is cemented to a rock on shore. His particular talent is the ability to extract lime from the water and to fashion it into a house of pure white limestone. It is about the length and thickness of a lead pencil and is a model of beauty and safety. The occupant, however, is not able to enter and leave at his pleasure. He is a prisoner within his castle, chained fast by strong muscles. When hungry, the worm opens a door at the end of the tube and thrusts out a circle of bright red tentacles. As the tentacles wave back and forth in the water some of them force food particles into the mouth while others act as air raid wardens and warn the worm of approaching danger. The tentacles are so sensitive to peril that the passing of a hand over the tube will cause the animal to draw in the feelers and close the door.

The plume worm believes there is safety in numbers, therefore a number of them build their houses close together. This is either for protection or for gossiping with their neighbors. Calling greetings from the front door is the plume worm's only opportunity for visiting because, like many of his relatives who have crouched in tubes for centuries, he has become securely fastened within. The tube, which is anchored between rocks, is made of a horny, coarse material and stands a foot high. Through long practice the plume worm has become an expert mason, able to repair the tube if it is damaged by storms or raids.

The clam worm is a daredevil that throws caution to the winds. His motto is: "Eat, drink, and be merry for tomorrow we die." He lives dangerously but in the end he pays for his recklessness. The clam worm's house is a loose, flimsy tube that he makes by gluing together sand grains and tiny stones. It does not protect him adequately and he is a prey of countless enemies. In fact his house is so poorly constructed that it crumbles when he leaves it and he has to build a new one after each excursion into the world. The clam worm usually stays at home during the day, but he misses none of the night life. Clam worms are particularly gay during the full moon of the summer months. At that time thousands of them get together for nuptial orgies. For several nights the water is full of worms swimming madly back and forth, but with the discharge of eggs and sperm their gay, mad days are over and they sink into the sea and die. Their mission in life is fulfilled.

The sea mouse depends upon camouflage for protection. This takes the form of a fur coat. A worm with a fur coat sounds like a joke but it is stern reality with him. This odd creature is called a mouse because he is somewhat the size and shape of his namesake, although really a worm covered with long stiff hairs on the upper side. He is not able to construct a house so in order to make himself inconspicuous he wallows in mud and sand until his fur is covered with dirt and debris. Then he crouches under a rock hoping his enemies will not spy him under his filthy trappings.

Let us take courage from the lowly worms. If the simple creatures of the seashore are able to devise effective and adequate protection against ever-present dangers, surely man with his intelligence and inventive genius is able to surmount the tribulations of war and finally turn them into social and scientific advances.

★

BROOK WATER

By ETHEL ROMIG FULLER

Brook water
Is froth-white lace
Knotted with ferns
At the dark breast of a hill

Brook water
Is taffeta sibilance
Under cascading lace ruffles.

To use this map hold it before you in a vertical position and turn it until the direction of the compass that you wish to face is at the bottom. Then below the center of the map, which is the point overhead, will be seen the constellations visible in that part of the heavens. It will not be necessary to turn the map if the direction faced is south. Time given is Standard Time; add one hour for War Time.

The Ringed Planet

By ISABEL M. LEWIS

Now is an exceptionally favorable time to observe the planet Saturn. On December first it will be in opposition to the sun and visible all night. It is in the constellation of Taurus a few degrees nearly due north of Aldebaran, and during the month it will move westward, or retrograde, about two degrees. It is much more brilliant than Aldebaran at this time, although at some oppositions it is not as bright as this star. It is also pale yellow in color, contrasting strongly with the reddish hue of Aldebaran. One should have no difficulty in locating it.

The rings of Saturn are now nearly at their widest opening and very beautiful to observe even in a small telescope. In April, 1944, the southern surface of the rings will be most widely exposed to view from the earth, but the appearance will not change greatly between now and then. The illumination of the surface of the rings by the sun adds to the brightness of the planet. The more surface exposed the greater the brightness. When, as now, at time of opposition, the rings are not only near their greatest opening, but the planet is also nearly at its minimum distance from the sun, its brightness is exceptionally great, in fact, almost as great as it can become. At this opposition the distance of Saturn from the sun is about 750,000,000 miles, as compared with 1,027,000,000 miles at an unfavorable opposition. As a result of this favorable combination of circumstances Saturn is now more brilliant than any of the stars except Sirius and Canopus.

Early in July, 1936, the rings were viewed edge-wise

from the earth. In February, 1937, they were again in line with the earth and had the appearance of a thin line of light. At that time the earth passed from the north to the south side of the plane of the rings. For fifteen years before that date the north side of the rings had been in view; from then on for another fifteen years the south side would be the visible one. Not until 1951, after the planet has completed one trip around the sun, will the rings again be viewed edgewise from the earth as they were in those years.

When the rings are extremely thin, as they were in 1936 and 1937, the light that reaches us comes chiefly from the surface of the planet and is considerably less than the light received when the rings are at their widest opening. The brightness of the planet varies also with its distance from the sun. At opposition in 1937, which came in September, the planet was not in the part of its orbit nearest to the sun. For this reason, as well as for the reason that the rings were very thin as seen from the earth, the planet was much less brilliant than it is now at time of opposition. In fact it is almost two and one-half times brighter.

In 1929 the rings were at their widest opening, but the north side of the rings were then illuminated while now it is the south side that we see. The brightness of the planet was then greater at opposition than in 1937 because the rings were at their widest opening. But the planet was in the part of its orbit farthest from the sun—which happens in June—and for that reason its brightness was less than it is now. It follows, in general, that the north side of the rings are not viewed under as favorable conditions as the south side.

At this time there is a combination of circumstances that gives an exceptionally fine view of the planet and its rings, if one has access to a small telescope. Since Saturn is now far north of the equator it will be seen to the best advantage in the northern hemisphere.

The cycle of change in the appearance and visibility of the rings of Saturn during its twenty-nine-and-one-half-year period of revolution around the sun arises from the fact that the rings lie in the plane of the planet's equator, which is inclined about 27 degrees to Saturn's orbit, and 28 degrees to the plane of the earth's orbit. As the planet's equator always keeps parallel to itself as the planet goes around the sun, the angle of elevation of the earth with respect to the plane of the rings ranges from about 28 degrees north of the plane to about 28 degrees south of it in the twenty-nine-and-one-half-year period.

Galileo, attempting to view this planet with his crude telescope, could not see the ring-system as such and was greatly discouraged by Saturn's peculiar behavior. At one time it seemed to him to have two appendages. Later, when the earth passed through the plane of the rings, they disappeared and he was greatly perplexed and exclaimed that Saturn must, indeed, have swallowed his children! He finally became so discouraged that he refused to look at the planet.

Even the smallest telescopes will show the ring-system of Saturn. There are in all three concentric rings. The dusky, or crepe, ring is the innermost of the three rings and is rather difficult to see. It is only faintly luminous and the ball of the planet can be seen through it. Its width is about 11,000 miles and its inner edge is separated from the ball of the planet by a space of about 7000 miles. The principal ring, and the brightest of the three, lies next to the crepe ring. It is about 16,500 miles wide and is brightest at its outer edge and fades gradually into the crepe ring without any sharp line of demarkation. Between this ring and the outer ring, however, there is a narrow gap known as Cassini's Division. It is about 3000 miles wide. The planet Mercury would fit into this gap very snugly. The outer ring is about 10,000 miles wide, and the total width of the three rings and Cassini's Division is about 41,500 miles. Five globes the size of the earth could roll along the ring-system of Saturn side by side with plenty of room to spare. The substance of which the rings are composed is meteoric dust or tiny moonlets, each traveling in its own orbit around the planet. As they are too small to be seen individually they give collectively the appearance of a luminous band of light. The thickness of the rings is estimated to be not more than ten miles. In comparison to the width this is almost infinitesimal. It is not strange that when viewed edge-wise the rings may disappear completely from view—even in a powerful telescope—for a few hours. The entire width of the ring-system from outer edge to outer edge is about 171,000 miles. No other member of the solar system and, so far as is known, no other object in the heavens has such an odd appendage. Saturn is also noted for the fact that it is the only member of the solar system that has a density less than that of water. In addition to its rings it has a family of nine satellites. Titan, the largest, may be seen in small telescopes and is greater in size than our own moon. Phoebe, the smallest and outermost, is probably not more than 200 miles in diameter. It revolves in an east to west, or retrograde, direction.

Saturn, like Jupiter, has belts parallel to its equator and bright spots sometimes appear on its surface. Its flattening at the poles is greater than that of any other planet. Its surface is less interesting to observe than that of Jupiter, because it is so much farther away that details of its surface markings are seen with difficulty. Its unique ring-system, however, gives it distinction

THE TELESCOPE

By EDYTHE HOPE GENEE

Through Science's eyes I peered one night,
To see the starry nebulae;
Instead of planets there I found
White gardenias in the sky.

White Robin

For two months an albino robin had created a bit of stir in Nanaimo, British Columbia, before John T. Cowie, amateur photographer of that community, was able to make the record above. The bird, and its more orthodox cousins, found hospitality in the yard of Edward Barraclough, who set out apples to attract the robins. Spotting the albino among the visitors one day, Mr. Barraclough called the photographer's attention to it. A shot from a basement window sill, and the picture was obtained.

Science Teachers

Members of the American Science Teachers Association will hold their annual meeting at the Hotel Pennsylvania in New York on Tuesday and Wednesday, December 29 and 30. In tune with the times one session will be devoted to a discussion of the teaching of science in war-time. All science teachers in the New York vicinity, or elsewhere, whether members of the Association or not, are invited to attend.

Dog Food Problem

At one time the slaughter of sea lions to provide raw material for dog food was a threat to continued existence of these animals along the California coast. Fortunately steps to safeguard them were taken. Now a whaling industry has been established in California waters, one of the products of which is dog food. It is to be hoped that this venture also can be curbed for certainly we should not permit dangerous exploitation of a wild animal resource for so unessential a purpose. There is little doubt that the United States would benefit economically and in other respects if its dog population were very greatly reduced. That may have to be done as a war, food-conserving measure but in any event, the dogs should not be kept alive if their maintenance is a threat to the existence of any wild creature. Animals that must be controlled, as jack rabbits, may well supply a quota of dog food, but the business is not one that should be allowed to grow unrestrained or to make its own regulations. Certainly the welfare of our native fauna should come before that of the largely dispensable dogs.

Owl Nesting

In the October issue we printed a note by John M. McBryde entitled "Mockingbirds and Owl", and he writes to say that in copying his notes he neglected to add the words "later on" to a sentence that, as it read, gave the impression that the barred owl nests in Louisiana in September or October. This is not the fact, he points out, records showing that they begin nesting by the first of January, and occasionally before Christmas.

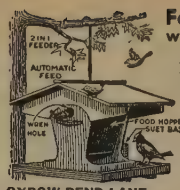
Three-Mile Rule

At its recent convention the American Bar Association adopted a resolution urging that in the interests of the preservation, development and rational exploitation of ocean fisheries, the three-mile rule be modified. The restrictions of this rule have operated to endanger a vital food resource and to complicate administration and regulation of the harvest of this resource. It has prevented effective control of over-exploitation. The Latin American countries have never acceded to this rule, and Canada and the United States have led the way in cooperative endeavor to improve the fisheries situation. It is, therefore, urged that there is no obstacle to a hemispheric program in the interests of fisheries conservation.

Have Any Nests?

"Bluejays built a nest between the screen and pane on the sill of an upstairs window and successfully reared four young at our house in the country," writes Hazel I. Chase, 272 N. Union St., Galion, Ohio. "I wonder if this is unusual. I have the nest.

"I would like to correspond with anyone interested in collecting birds' nests. Especially desire humming bird or other small bird nests. They must not be nests taken while birds are using them. Would never be without *Nature Magazine*."



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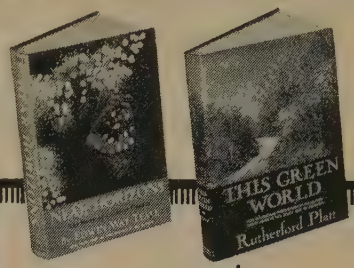

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The School Page

By E. LAURENCE PALMER

Professor of Rural Education, Cornell University, and Director of Nature Education, The American Nature Association

SCHOOL SPIDERS

WHEN I was a youngster, I read in an old *St. Nicholas* a verse by Blanche Elizabeth Wade that started,

"We ought to study Nature just from books, is what I say,
It does not do for Teacher dear, in any other way,
Because when once I found a spider brown, and very fat,
And brought him carefully to her in my best sailor-hat,
My teacher cried aloud in fright, and squealed, and took on so,
I had to hurry to the door and let my spider go."

Somehow, that verse has stuck in my memory all these years, and somehow it has helped me define my philosophy of Nature Study. It involved no high sounding generalizations. It portrayed perfectly the reactions to natural history stimuli of all of my elementary school teachers but one. And it encouraged me to think that I was like many other youngsters in my desire to see what snakes, snails and "worms" would do under the great variety of stimuli I was only too glad to apply to them.

To some teachers, it may seem strange to suggest that spiders be studied at this time of year. True, those in the warmer parts of the country can find them in abundance at any of the four seasons. But even in the colder northern states the housewives know that spider webs may be found hanging from the home ceilings almost throughout the year. Ask the janitor or the pupils if there are any spiders around, and whether you are teacher or supervisor you may be led quickly to some most interesting subject matter.

Now that we have found a spider, what shall we do with it? Well, the best thing to do is to follow the suggestions that may come from the children. Poke it, cool it, warm it up, put it in the sunlight, put it in the dark, put it on water or put water in it, drop it, wave your hand at it, try to feed it various things. Or just leave the spider alone to see what it will do. If it has a web, this may be disturbed, but even if it has a web the spider may not be seen. All summer a spider has lived on our dining room chandelier. Once a week or oftener its webs are wiped off, and within a day or so there are new ones. How does this spider—and the spider in your school—manage to survive? How does it spin a web across a two-foot open space? The first time you see a spider expel its silken thread and use this fresh thread for a bridge, you realize how uniquely this animal has been able to solve the problems of space mastery. Last night I had occasion to walk repeatedly down a woodland path. Three times I had gone down it without any evidence that there were spiders present. The fourth time a spider web struck me across the face. It had not been there a minute earlier. How did it cross that distance so quickly?

Spiders at Night

I like to study spiders at night, with a flashlight or without one. A few weeks ago I was with a group of friends in a dark woodland about midnight trying to see what we could see and hear at that time of night. We discovered a faint gleam some seven or eight feet off the ground. A spider had captured a firefly whose light continued to glow as his life waned.

A few weeks ago my family physician called me up near midnight all excited over the fact that he and a neighbor had just found a spider eating its web in the middle of the night. Of course he will remember that experience longer than had he read about it in school, and longer than you will recall it after you read this article. Yet a common animal of his neighborhood was doing the same sort of thing it has always done, in the way it had always done it, and yet hitherto he had missed seeing it.

It was only a comparatively short time ago that anyone had ever kept detailed notes on what a house spider does when she makes the pear-shaped cocoons she hangs in her web. I well remember Dr. H. E. Ewing describing, at a meeting some twenty-five years ago, what he had seen this common animal do. It is possible that my interest in spiders started with that description, although it is safer to say that the description whetted my appetite to know more about them. I mention this to show that here is a living animal to be found in any school at any time of the year—an animal that can be used to illustrate psychological behavior, phenomenal reproductive activities, unique food-getting habits and spectacular space-mastering techniques. Just jar the web of a house spider and observe in detail what it does. Jar it again to see if it does the same things in the same order. Repeat the stimulus to see how regularly and orderly the spider reacts.

Spiders in Winter

Of course, there are spiders in the school yard in winter as well as under the school-house roof. Even in the coldest weather spiders may be found numbly moving about if a snow-buried log is disturbed. On sunny days spiders may be found making their way deliberately over the surface of snowbanks. Get a few of these winter wanderers and try to find if there is any local temperature that completely stops them from prowling about. Hanging in the weed-tops along a fence-row near school may be found the hickory-nut sized cocoons of the common garden spiders. You remember them as the rather gaudy spiders that made the huge wheel-like webs in the plants at the edge of your garden. The adults of this last season are now dead and gone, but the new generation is starting life during the coldest winter weather inside these cocoons. I could tell you what is happening in the cocoon but you will get more fun out of it if you, and your pupils, discover it for yourselves. Here is one important study in biology to be made outdoors in the dead of winter that you cannot make next summer, and if you make it you will appreciate more than ever that beautiful spider of your garden.

I am tempted to offer to send cocoons for study, but that would rob one of the pleasure of finding them. Anyway I think I learned my lesson about offering to send my readers things when I offered to trade seeds from my garden with those who read my article on fall flower gardens in the October issue of *Nature Magazine*. I am still hearing from those people from New England, Florida, California, Washington and points between.

Spider Superstition

If we recognize as we should that the study of Nature or science tends to destroy unwarranted prejudices, then spider study should be a required part of outlines

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in these fields. Make a list of the local prejudices about spiders. Then select almost any other animal at random and see if it has as many associated misunderstandings.

Then see if you can find a spider trapped in its own web. If there is an orb web available for examination, touch the "spokes" and the "rims" of the wheel to see which are sticky and which are not. Try to figure out what difference this might make to a spider. Are the rims always sticky and the spokes not?

If you get in the habit of testing spider webs you may become fascinated by the various modifications to be found there. Some you will find have shelters for the builder. Some have "stabilizers" that permit a web to be tightened or relaxed as the need exists. Others have special outside threads that upset passing insects and cause them to fall into the nets below. In fact, so varied are these webs that you may decide you would like to make a collection of the types you find. At first thought this may seem absurd, but schools may make excellent collections of spider webs.

To preserve a web for a collection, it is best to provide yourself with an atomizer, or a spraying device such as artists use to spray pencil and charcoal drawings. Then take some white shellac and mix it so that it is thin enough to be taken up by the sprayer. The shellac may be thinned with alcohol if this is necessary. Now go to the web you wish to preserve. Spray it thoroughly with the white shellac. Then take a black card and draw it with one motion through the web. The shellacked web strands will stick to the black card and show as slender white streaks. These will stand ordinary school-room use, but it may be safer to keep a tissue paper cover over the web except when it is being studied.

There is little need of elaborate terraria for the study of spiders. A small bottle or fruit jar may be sufficient for most kinds. Most species can live rather long periods without food, but of course they should not be starved. Little bits of meat may be eaten by some, but usually they prefer to catch what they eat fresh. A jar that yields fruit flies may be attached to a jar in which you keep your spider so that the surplus flies escape to the spider's "parlour" for the well-known ceremonies.

The insert section of this number of *Nature Magazine* should provide some introduction to the commoner kinds of spiders and their kin. With its help, get acquainted with the spiders that live with and near you.

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SPIDER-WEB PAINTING

(Continued from page 540)

into a single pair of grayish gloves and a pair of gray stockings! Other experimenters devised a sort of scaffold for holding the spider, and a reel for winding off the silk threads as they emerged from the openings of the spinnerets. From 25,000 spiders they finally managed to secure sufficient silk for the weaving of eighteen yards of eighteen-inch golden-yellow fabric, which was exhibited, to the wonder of all beholders, at the Paris Exposition of 1900.

"Here shy Arachne winds her endless thread,
And weaves her silken tapestry unseen,
Veiling the rough-hewn timbers overhead,
And looping gossamer festoons between."

—Elizabeth Akers.

Any information concerning spider-web painting that readers of NATURE MAGAZINE may wish to send to the author will be most gratefully received.

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BUBBLE MAKES PAGE ONE

(Continued from page 523)

the neighborhood, but the many weedy vacant lots and tall pine trees gave plenty of shelter for one small gray squirrel. Her cage stayed open, hopefully. We put peanuts out in handy places. Tame from infancy, Bubble, we knew, must depend on instinct rather than experience for subsistence.

Finally we heard from Bubble—on the front page of our morning paper. She had adopted a friendly elderly couple five blocks away, and had gone in for housebreaking. That was why she was in the paper.

Houses, to Bubble, were places to live in. Thus, she continually tried to get into her new friends' house. Failing that, she climbed to the roof of the closed-up house next door, scrambled or fell down the chimney, and was imprisoned in the empty, locked and shuttered dwelling.

Her new friends looked on helplessly as she scratched anxiously at them through the window. They called the police, the fire department, the humane society and the newspaper. A policeman, a locksmith, half a dozen neighbors and a troop of little boys on bicycles gathered. The locksmith pried a pane of glass from the door, and, with the policeman supervising, Bubble was rescued.

The center of an admiring crowd, she was showered with pecans, peanuts and cookies. Even the law guardian was captivated, staying long after his job was done in order to have Bubble sit on his shoulder and eat a cookie.

Now Bubble is home again—caged but contented. She spent her first two days at home sleeping, when she was not eating. Apparently she had neither eaten nor slept well during her period of freedom.

We wish we could know all the things that happened to her; all the adventures she must have had. We do know that her left hind leg is almost useless but we can only speculate as to what happened. Did a misguided young huntsman shoot her with a B-B gun? Was it a hungry cat or a dog? Or was she injured in her tumble down the chimney? Only Bubble knows and she merely twitches her whiskers and nibbles a peanut when we try to question her.

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NATURE IN PRINT

(Continued from page 538)

Fading Trails is a consensus of conservationists, yet with skillful editing by Charles Elliott it contains a wealth of incident, anecdote, and color, in a style of writing that holds interest from beginning to end. Furthermore, the volume includes three dozen of Walter Weber's line drawings and paintings—four in color—and these by themselves make it a good fortune to own the book. It is indeed a credit to Weber's art that it can be so satisfying though reproduced in a volume seriously slighted by the publishers when allotments for typographical work were being made.

Conservationists assuredly owe a debt to Daniel B. Beard who conceived this volume and was chairman of its committee of authors, from the Fish and Wildlife Service and National Park Service—Frederick C. Lincoln, Victor H. Cahalane, Hartley H. T. Jackson, and Ben H. Thompson. Only in its validity, however, does *Fading Trails* have any aspect of committee writing. Better than many works by single authors, it stands as a unit of writing that will enhance any library. It is often eloquent, as in its description of the roseate spoonbill:

"Surely the forces of Creation had given way to an impulse, had indulged in a creative splurge, had felt a sudden and overwhelming desire for something closer to beauty than giant sloths, or glyptodonts. For here was a bird with plumage of a more delicate pink than the most fragile shell or the loveliest sunset. And splashed across its shoulders was a final dash of crimson which for sheer inspiration anticipated all of the great masters and outdid them."

The volume has the emphasis that goes with sincere conviction. In its chapter on the Florida crane it speaks out with exclamation points:

"Like so much American wildlife, it has one (enemy) which is too powerful—man! That Number One enemy always!"

And the book has the breadth of vision that also is possible with sincere conviction. "Perhaps the greatest shortcoming of the conservation movement," it observes, "has been the failure to recognize that all kinds of wildlife—the hawk, the sparrow, the fish, the game bird, the frog, and the deer—are equally important in land planning."

Fading Trails is indeed a fitting conclusion for a year that has had the benefits of many good books. It should do much to help keep wildlife as much alive in our world as it has been in our literature.

Who Goes to the Wood. By Fay Inchfawn. Philadelphia: The John C. Winston Company. 1942. 229 pp., with 93 line drawings, colored frontispiece, and end papers by Diana Thorne. $2.

Mountains. By Carroll Lane Fenton and Mildred Adams Fenton. Garden City, N. Y.: Doubleday, Doran & Co., Inc. 1942. 160 pp., with 80 photographs, 73 drawings, and end-paper map by the authors, 2 kodachrome plates by John Kabel, and index. $2.50.

Wild Animals of the Rockies: Adventures of a Forest Ranger. By William Marshall Rush. New York: Harper & Brothers. 1942. 296 pp., with 20 photographs. $3.

Fading Trails: The Story of Endangered American Wildlife. Edited by Charles Elliott; prepared by a committee of the United States Department of the Interior, National Park Service, Fish and Wildlife Service, Daniel B. Beard, chairman, Frederick C. Lincoln, Victor H. Cahalane, Hartley H. T. Jackson, Ben H. Thompson. New York: The Macmillan Company. 1942. 279 pp., with 12 line drawings and 24 paintings (4 reproduced in color) by Walter Weber, selected bibliography, and index. $3.

In an Insect Garden

Near Horizons. By Edwin Way Teale. New York. 1942. Dodd, Mead and Company. 319 pages. Illustrated. $3.75.

Readers of Nature Magazine have had a partial preview of this fine book through articles that appeared in the May, August-September, and October, 1942, issues. These articles, expanded or rewritten, provide three of the thirty fascinating chapters in the book. This is the story of an insect garden on a Long Island hillside where stands a weather-beaten barn and on which grow old apple trees. A stream winds through the acres, and Nature and the author have planted shrubs and vines, wild flowers and cultivated plants attractive to insects. In this garden Mr. Teale has studied and photographed the wide and fascinating variety of insects that dwell there. More than 160 of his splendid pictures illustrate the book. The text is popular and delightful reading, and the publishers have collaborated in the production of an outstanding book that should enjoy even greater popularity than the earlier insect books by Mr. Teale that were so well received.

Rocky Mountain Plants

Meet the Natives. By M. Walter Pesman. Denver. 1942. Published by the Author at 372 South Humboldt Street. 216 pages. Illustrated. $1.25.

In his introduction to this guide the author says: "Just between you and me—don't buy this book if you know too much." He points out that it is not a book for botanists. It was prepared in the conviction that the amateur is interested first of all in the plant itself and not in small details. It seeks to aid those who want to know the widespread, conspicuous, beautiful and interesting trees, shrubs and wild flowers of the Rocky Mountain region. More than seven hundred plants are classified, first, according to life zone, then, color, and then, season of bloom. The descriptions are terse and should be adequate.

Nature and Camera

Natural History with a Camera. By L. W. Brownell. Boston. 1942. American Photographic Publishing Company. 292 pages. Illustrated. $3.75.

L. W. Brownell has devoted his life to Nature photography and one can hardly pick up an illustrated Nature or science textbook without finding therein some of his pictures. With such a background Mr. Brownell is notably equipped to give the advice and information in this volume. Feeling that Nature photography requires a good working knowledge of Nature, where to find certain flowers or trees, birds or reptiles, and to know what is what, the author has subordinated the mechanics of photography to the natural history advice. His book is arranged in chapters for each month, beginning in March and concluding with February. The result is a most valuable volume for anyone who undertakes recording the facts of Nature on film.

North Carolina Birds

Birds of North Carolina. By Thomas Gilbert Pearson, Clement Samuel Brimley and Herbert Hutchinson Brimley, Raleigh, N. C., 1942. N. C. State Museum, 416 pages. Illustrated. $3.50.

This is a revised edition of a work of the same title, and by the same authors, first published in 1919. The increased knowledge and interest that have grown up in the past 20 years, in large part as a result of the first issue, have created a demand for a new edition, and this is admirably met by the present volume. The authors have had the help of many collaborators throughout the State and elsewhere. In fact, the names of those who rendered signal aid reads almost like a list of our more active eastern ornithologists. This feature, of course, adds greatly to the value of the work.

The formal list treats 396 species; the appendices include a bibliography of 20 pages, and a condensed account of the times of occurrence of the more notable summer visitors, winter visitors, transients, and stragglers, some 175 species being thus treated.

While the make-up of the book precludes the use of large color plates, there are 14 full-page plates in color of selected species, by Horsfall, and about twenty of Peterson's well-known and excellent reduced plates of groups of species in colors or black and white—gulls, terns, herons, ducks, geese, sandpipers, rails, woodpeckers, swallows, vireos, warblers, grosbeaks, starlings, sparrows and others. These, and the numerous fine text figures, make the book compare not unfavorably, as to illustrative value, with some of the more pretentious volumes of other states.

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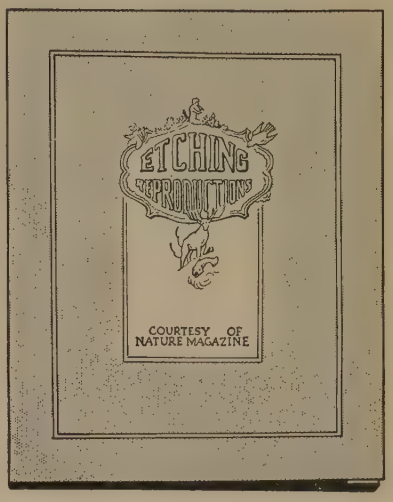

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Under the Microscope

By JULIAN D. CORRINGTON

Antoni van Leeuwenhoek (1632-1723), first and greatest amateur microscopist.

ADVANCED HINTS

1. Preparations for the Study of Mitosis

Theoretically one should be able to observe mitosis in any type of cell. However, the process is evanescent and occurs much more frequently in some cells than in others, particularly in certain stages of the life cycle. Obviously embryonic tissue would be better than adult, since the rate of embryonic growth is so much greater. Such highly specialized mature cells as spermatozoa and nerve cells do not divide at all. Some structures are easier to obtain or to process than others.

If a cross section of some small animal, as a salamander, is stained with the proper dyes, it will be possible to find, by long and patient search, a mitotic figure in one phase or another in skeletal muscle, intestinal epithelium, skin, or other organ. But such isolated figures will scarcely serve for a study of the entire process. Experience has shown that certain forms will yield finer results more easily and certainly, and hence these have become stock examples for the subject.

Outstanding as favorites are root tips of onion, hyacinth, iris and tradescantia, and the anthers and ovaries of the lily among plant cells; for animals, germ cells are preferred, including sections of the testis of crayfish, grasshoppers, or salamanders, and the eggs of the roundworm, *Ascaris*, of worms, mollusks, and especially of the whitefish. The onion root tip is so classic that an account of standard methods for this preparation will serve our present purposes. Other root tips are processed similarly; animal spermaries are not difficult, but *Ascaris* and whitefish slides call for special and advanced skills and should not be attempted by the beginner.

Support an onion on a ring in a shallow vessel of water so that the lower half is immersed; allow to remain until numerous roots have developed. The onion has peculiar growth habits; investigators have discovered that mitoses are much more frequent at the hours of 11 P. M. and 1 P. M. than at other times, therefore the operator should remove and fix the root tips at either of these hours. Sever the extreme tip of new roots for a length of ¼ inch and place several in the fixer. Any of the Flemming mixtures or Bouin's are excellent for this technique, but we shall choose Nawaschin III (also spelled Navashin) to introduce a new reagent, and one that gives consistently excellent results.

The various Nawaschin formulas are mixtures of chromic and acetic acids and formalin, known as "craf" formulas, a word obtained from the initials of the ingredients. Number III consists of 30 cc. 1% chromic acid solution, 20 cc. 10% acetic acid, 10 cc. commercial formalin, full strength, and 40 cc. distilled water. The craf reagents do away with the expensive and dangerous osmic acid of Flemming mixtures, and will not overfix; material may remain in the fixer for weeks or even years. The formalin should not be added until just before using.

Fix for 12 hours, then pass without washing to 30% alcohol or acetone for 30 minutes, 50% for 30 minutes and 70% for an hour. Store at this stage until able to continue the remainder of dehydration, infiltration, and imbedding without pause. Place the root tips in 82% alcohol or acetone, 1 hour, 95% 1 hour, then absolute alcohol or anhydrous acetone, 3 changes, 1 hour each. Dioxan or the butyl alcohol technique may be used instead of alcohol.

For best results, the passage through xylene or other clearer should be gradual. The first jar should contain ¾ absolute alcohol (or anhydrous acetone) to ¼ xylene; the second jar, half and half; the third, ¼ alcohol or acetone to ¾ xylene; and the fourth jar pure xylene; 30 minutes in each. Infiltrate gradually also, making sufficient changes to insure that all of the xylene is removed and replaced by melted paraffin. Cut sections 10 microns thick, in the regulation manner, and affix several per slide. After drying 24 hours, the affixed sections are ready for staining.

Pass the slides through xylene to remove the paraffin and run them down the alcohol series to water, or employ the dioxan or cellosolve procedures. One of the simplest dye combinations is the safranin—fast green technique. Overstain in a 1% aqueous solution of safranin, overnight or for 12 hours, rinse in water, and dehydrate rapidly through the ascending series of alcohols, as they extract the dye. From 95% alcohol, counterstain in a 1% solution of fast green in 95% alcohol, 10 seconds, complete the dehydration, clear, and mount in balsam. If slides are too red, leave for a longer time in the higher alcohols or the green stain; if too green, leave a longer time in the final absolute alcohol. A bit of practice will enable the operator to turn out excellent slides with brilliant red chromosomes set off by a pale green cytoplasm.

An even more beautiful combination is crystal (gentian) violet and orange G, yielding violet chromo-

somes against a gold-orange background. Best of all of these color combinations, however, is the celebrated Flemming's triple stain, safranin-violet-orange, which gives red chromosomes, violet spindle, and orange cytoplasm in successful preparations. All three stains are tricky, being dissolved in alcohols or other dehydrators, and reacting with each other, so that experience through trial and error is necessary, and not all slides will turn out acceptably. A few perfect slides will more than repay time and materials expended.

Use 1% aqueous solutions of safranin and crystal violet, but a saturated solution of orange in clove oil. Stain first in safranin, overnight or 12 to as much as 24 hours; wash well in water to remove excess—three changes should suffice; stain in crystal violet 10 minutes, or longer as trials may show to be necessary; pass through three rinses in water; dip for a moment in 50% alcohol, then into 95% alcohol and three changes of absolute alcohol, not more than one minute in each; flood sections with a pipetteful of the orange G in clove oil, drain after one or two minutes and flush with pure clove oil to remove excess orange. Keeping the preparation wet with clove oil, differentiate under the microscope. This reagent removes both the safranin and violet, and should be flushed from the slide with a pipetteful of half clove oil, half xylene, followed by a pipetteful of pure xylene as soon as the destaining action has progressed to the desired point. Finally, pass through two jars of xylene, 5 minutes each, and mount in balsam.

Most widely used of all chromosome stains is the iron hematoxylin technique, which presents black chromosomes; the background may be tinged with such a counterstain as fast green, eosin, orange G, or left uncolored, as desired. Details appeared in this Department for October, 1939, but a brief outline can be added here to complete the subject of chromosome technique. Mordant the slides for 4 hours in 4% iron alum in water; rinse thoroughly in distilled water, five or six changes, 1 minute each, recommended; hematoxylin, 4 hours (overstain); wash well in distilled water; differentiate in a 2% iron alum, controlling under the microscope by examinations at intervals until the dye has been extracted from cytoplasm, plastids, etc., but remains dense in the chromosomes; wash very thoroughly in distilled water, then dehydrate, clear, and mount.

2. Chromosome Smears

One of our illustrations in November shows a smear preparation of the giant chromosomes found in cells of the salivary glands of certain fly larvae, notably *Drosophila* and *Sciara*. Place several mature larvae in a watch glass with Ringer's solution for cold-blooded animals, or normal saline and, under low magnification, grasp each end with a forceps and pull the animal apart. Usually the larva will break just behind the head region and the salivary glands will come free. They are minute, curved, elongate, whitish bodies, two in number.

Place these glands in 45% aceto-carmine, 15 minutes, then transfer to a slide which has been lightly coated with albumen fixative and that has been allowed to dry. Remove excess stain with a torn fragment of filter paper, and add 50% aceto-carmine. Run a finger along the side of the nose or through the hair to obtain a fine film of oil and apply this to one surface of a cover glass, then mount this glass, film side down, on the salivary glands and press gently so as to mash them, thus rupturing the tissues and freeing individual cells. Blot off any excess stain, then expose the slide to fumes of 95% alcohol for 24 hours. Then soak the cover glass off in a dish of 95% alcohol, prying with a toothpick if necessary, and mount in euparal or diaphane, with a fresh cover.

To make the stain, add carmine to boiling acetic acid of the indicated strength until saturated; ½ gram or less will saturate 100 cc. of the acid. Cool and filter. Belling's iron aceto-carmine is a modification preferred by many: dissolve some ferric hydrate in 45% acetic acid and add from 1 to 3 drops of this to the regular aceto-carmine stain, giving it a bluish-red color; but do not add so much as to cause any precipitation. The iron makes the chromosomes stain more intensely. Add to this treated stain a like amount of untreated stain, stir to mix, and employ as already detailed for ordinary aceto-carmine.

Exposing the slide to fumes of alcohol and at the same time preventing drying out, is done in a piece of apparatus termed a moist chamber, or in its opposite, a desiccator. While commercial models of these items may be purchased, if one does not have constant use for them a homemade substitute is just as satisfactory. Obtain a small square of plate glass, as from a broken auto windshield, or use any similar surface that is perfectly flat and level. Over this invert any small

Background for the Microscope

Equipment for the pursuit of microscopy may be as simple or as elaborate as individual inclinations dictate; but there is one item wholly indispensable —*books!* The microscope is handmaiden to all the sciences, and those who follow its adventuresome trail must have many a guide to direct along the right path.

Here is NATURE MAGAZINE'S selection of best bets. Check your library and add those who fail to answer the roll call. Buy one each month, or as often as you can. Suggest them as gifts. Buy them for the relative or friend whose chief joy is working with his microscope. Entries will be changed periodically; here is a basic list for a starter:—

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piece of glassware that will enclose the slide completely, such as a fingerbowl or specimen dish. Wet the circle of contact or apply a very thin film of vaseline to the edge of the bowl, the idea being to make the interior chamber air-tight. Alongside the slide place a small, flat, shallow vessel (watch glass) of the alcohol, so as to saturate the contained air with its fumes; or place several strips of filter paper or paper toweling, soaked in the alcohol, alongside the slide.

These salivary gland chromosomes are more than 100 times as large as in other parts of the body, and instead of being condensed and staining with a uniformly solid intensity, show many alternating bands of dark and light hues. The suggestion has been advanced that chromomeres visible in these bands are actually the genes, but this idea has not been generally accepted.

Aceto-carmine smears are also used on very tiny fragments of fresh anthers, following much the same procedure as outlined above.

3. The Fuelgen Reaction

This is a fairly recent and quite notable technique, originally presented by Fuelgen and Rossenbeck in 1924 as a microchemical test for the specific type of nucleic acid encountered in chromosomes. It positively distinguishes chromatin from any similar substance, and innumerable variations and improvements have appeared since its introduction. Students especially interested are referred to the October, 1936, issue of *Stain Technology*, where one of the best improvements is given by J. A. de Tomasi.

For those of our readers who are sufficiently advanced, the following outline procedure is suggested, using any slides desired, though some known to contain good mitotic figures are preferable, at least at first.

Dissolve 0.5% basic fuchsin by pouring over it 100 cc. boiling distilled water. Shake thoroughly, cool to 50° C., and filter. Add to the filtrate 10 cc. N hydrochloric acid, then add 0.5 g. potassium metabisulphite, shake well, stopper tightly, and store in the dark for about 18 hours—not less than 12 or more than 24, as a rule. Best results will be obtained if all reagents are of highest purity. The fuchsin should be certified as suitable for the Fuelgen reaction, the water glass-distilled, the other ingredients of c.p. quality. The N HCl can be made by adding 82.5 cc. HCl to 1,000 cc. distilled water.

In staining, run the slides down to water and rinse in cold N HCl, then pass them into fresh N HCl and heat this rapidly to 60° C., but no higher, keeping them there 4-5 minutes. Rinse in cold N HCl, then in distilled water. Stain animal tissues 2 hours, plant structures 3-5 hours; the stain should be colorless or no more than a faint straw color. Drain the slide, then pass at once into a series of three capped coplin jars, 10 minutes each to wash and differentiate. Each jar contains the following mixture: 5 cc. N HCl, 5 cc. 10% aqueous potassium metabisulphite, 100 cc. distilled water. Rinse in distilled water and dehydrate. Counterstain animal tissues for 3-5 minutes in orange G, plant tissues for one minute in fast green. Rinse in 95% alcohol, dehydrate with absolute alcohol, clear, and mount in damar. If this mountant is not available, use a strictly neutral balsam.

PERTINENT BOOKS

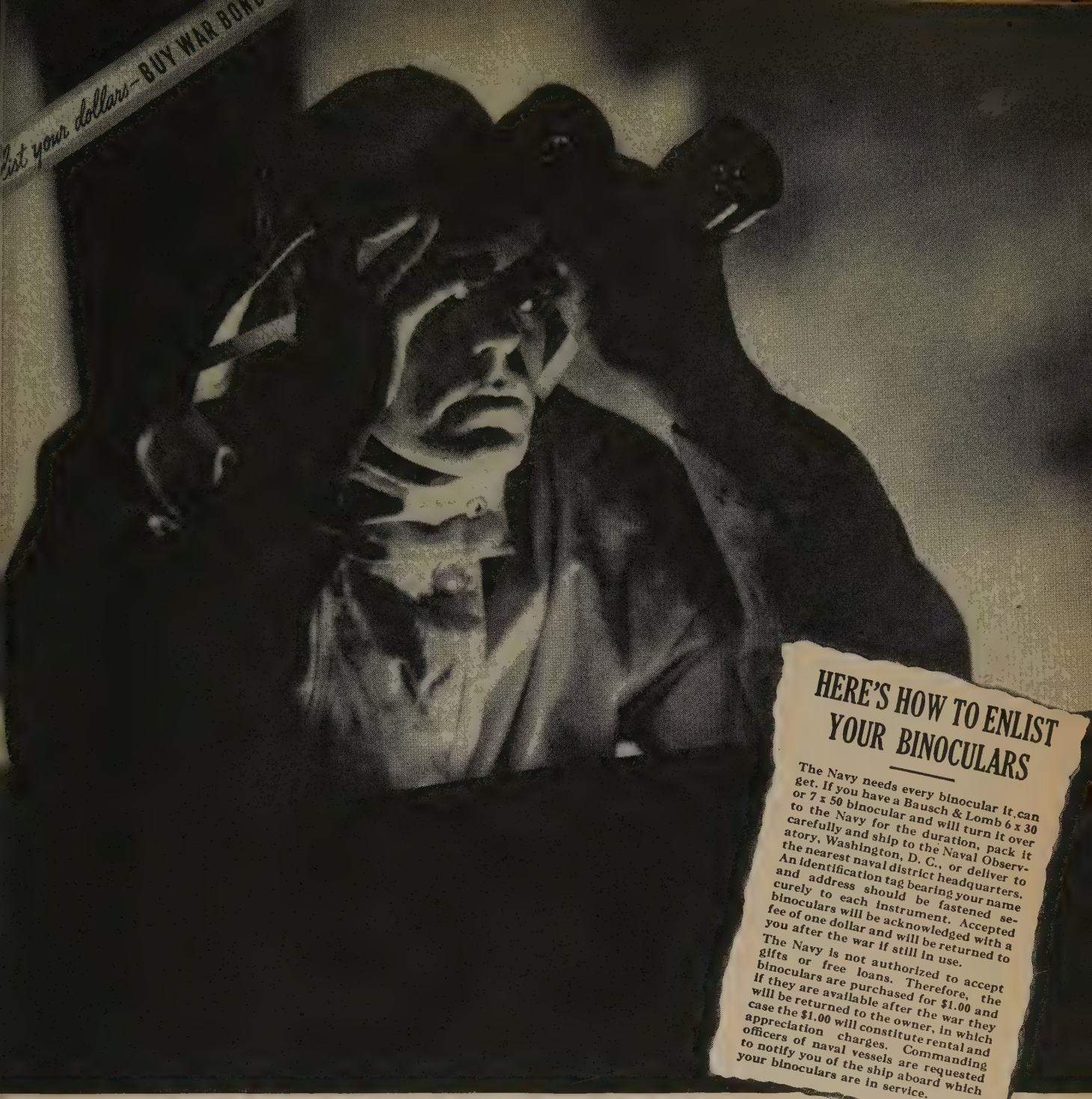
Continuing the bibliography bearing upon the feature of last month's in this Department, and on the supplemental material presented this month, we should consider several more titles.

One of the latest additions to this bibliofamily is *Elements of Genetics*, by Professor E. C. Colin, of Chicago Teacher's College, and lives up to its title by refraining from going off into advanced topics that lose and discourage the beginner. More attention is paid to the life and work of Mendel than usual, followed by clear, detailed, and elementary presentations, well illustrated, of Mendelian laws and problems, with special emphasis on their applications to plant and animal breeding and to man. Up to date, well written, and very informative; suitable for classroom or individual instruction; has problems and glossary. Pp. xii, 386; figs. 47. The Blakiston Co., 1012 Walnut St., Philadelphia, 1941. $3.00.

The *Principles of Genetics*, by Professor E. G. White, Wilson College, is another new work, and of the broader, somewhat more advanced type. An immense amount of material is covered, so that most explanations are brief, as if the work were a condensation from one several times larger. There is too much material for an introductory text, but the book is well suited as a reference or for supplementary reading. The illustrations are numerous and well chosen, but sometimes suffer because of the poor quality of the paper used. The subject matter sticks to genetics proper, with attention to eugenics, and there is an appendix on methods. Pp. 352; figs. 179. C. V. Mosby Co., Pine Blvd., St. Louis, 1940. $2.50.

Most comprehensive of all in subjects covered is *Evolution, Genetics and Eugenics*, by Professor H. H. Newman, University of Chicago, 3d edition. The original plan was expressed in the title to the 1st edition, *Readings in Evolution, Genetics and Eugenics*, which consisted almost entirely of selected readings and extracts from a multitude of classical and authoritative works and references on these three voluminous subjects. It was a source book of great value. To meet the criticism that the book was too disjointed to serve as a text, the author has reorganized and integrated the material, and relegated some of the longer extracts to an appended, separate chapter. Evolutionary biology has the lion's share of attention and we venture to say that if a 4th edition appears later it will show considerable expansion in the genetics section. Improvement would also be effected by more numerous illustrations. Well conceived, planned, and written, there is no other work that can take the place of this book and, though ten years old in a rapidly developing field (genetics), it is still the best for overall mastery of these three integrated fields, and suitable alike for beginner or advanced reader. Pp. xxiv, 620; figs. 100; bibliography, glossary. The University of Chicago Press, 5750 Ellis Ave., Chicago, 1932. $3.50.

For those already versed in modern science, including genetics, we can recommend a new work by the distinguished British scientist, J. B. S. Haldane, *New Paths in Genetics*. This is not at all a text, but a series of lectures for collateral reading. The titles of the five chapters are: the science of genetics, genetics and biochemistry, genetics and development, the genetics of some human abnormalities, and the formal genetics of man. Latest findings are applied to point out the most profitable direction of future research in agriculture, animal breeding, and human diseases, and for those who know only the standard, introductory subject, there are eye-opening sections on the applications of genetics to researches in biochemistry, sociology, and medicine. Pp. 206; figs. 17; tables 10. Harper & Bros., 49 E. 33d St., New York, 1942. $2.50.



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BACKYARD BATTLE

By Henry Leighton

While the world is aghast at the global warfare of many races of the human family, miniature battles rage beneath our feet. One late afternoon droves of large brown ants raced down over the rocks of our rock garden and across a stretch of lawn about five feet wide toward a flower garden next the house. In the grass, which to them no doubt was a dense forest, they met the black ants, defending their flower garden paradise and their young.

The battle was fierce, as the browns, who far outnumbered the blacks, attacked in little groups all through the grass. Each black was caught by the neck by one or by a squad of brown warriors and quickly killed. The fight raged for perhaps an hour or until all the available black defenders had been tracked down and eliminated.

The next morning saw the depleted ranks of the black ants removing their dead. The next afternoon hordes of invading brown ants again descended through the rocks of the rock garden, crossed the lawn without interference, and returned, each carrying a white pupa (which some call "ant eggs") of a black ant. Traced to the source of supply, the brown ants were seen issuing from a hole in the flower garden, evidently the home of the unlucky black ants they had defeated. Hundreds of the helpless shrouded prisoners were carried swiftly across the lawn and over the rocks and far away, to grow up as slaves of the conquering tribe. For an hour they carried their slaves away till the nest was empty.

Ants in Action

The following is an excerpt from a letter from Sergeant Robert O. Law to his mother, who has kindly sent it on to us. It is a graphic and splendidly written account of the activities of parasol ants, and we do not believe that it will give aid and comfort to the enemy to say that the observation was made in Panama. Sergeant Law writes:

The other day, Guy Franceschini and I were taking a short-cut to the Non-Commissioned Officer's Club when we observed a long column of ants each of which was carrying a portion of a leaf over his head as though it were a sun-shade. They were marching in a long line at the bottom of an embankment and because of the countless times they had made the trip they had packed down the dirt into a clearly-defined path. We back-tracked until we found where they were working.

Some one hundred feet from the embankment there was a stand of plants having a peculiar leaf. When we picked a leaf and crushed it we found it had a somewhat subtle perfume that was pleasing. It was about this time that we noticed we were dealing with two distinct types of ants though they were obviously of the same general species (red ants). The larger of the two types was about one-half inch long with sturdy legs and an enormous set of pincers up forward. These menacing pincers reminded me of those of a June bug. The second type was slightly more than one-quarter inch in length and looked much like the black ants we have at home save for the fact it was red.

The plants were covered with the larger ants who rushed around at top speed as though attempting to decide just which leaf was the most desirable. When one of the big fellows finally made up his mind, he would crawl down to the stem of the leaf right where it joined the plant stalk, hang upside down and go to work with his pincers. After about three minutes work he would have detached the leaf and it would float down to join the pile at the bottom of the plant. This pile of leaves was swarming with another group of the big ants which would grab the leaves and haul them to one side where they would get down to work, clipping them into one inch lengths.

At this stage of the game the smaller ants would appear on the scene, seize one leaf section and take off in the general direction of the embankment at a dead run. Those hundred feet to the embankment were incredibly difficult. There was a ditch about two feet deep and three feet across that was filled with sticks, rocks and debris. Beyond this ditch there was a heavy growth of swamp grass. All of these hazards seemed to have little effect on the determination of the ants to bring home the bacon. Whenever an ant's leaf would become hung up he would rush around impatiently and tug at it from first one side and then the other. Within a moment or two he would be joined by another ant and, if necessary, by several ants who would help him get under way again. When he got into motion the ant assistants would return to the obstruction and wait for the next chap to get his load hung up.

When the ant finally emerged from the jungle of grass he would join the throng that was rushing along the base of the embankment at top speed. There were hundreds of them with their green leaf sunshades and their path resembled a green carpet. Finally they turned and started up the embankment, which was almost perpendicular and about fifteen feet high. Here again there were assistants to give a hand to those who faltered. And hanging on by their toes they hoisted each and every leaf section up those dizzy heights.

About two or three feet from the top there was a sort of platform and the main entrance to the nest. The entrance was about one inch high and four inches wide and was so placed that it was impossible for rain water to seep in. The whole gang galloped in on a double quick while on the other side of the doorway a steady stream of ants went rushing back to the salt mines. I located five entrances on the side of the embankment and when we got to the top I found four more.

While the main gang brought leaves up to the side entrances another group composed of both types of ants hurried up out of the depths to the top entrances, bringing sand and gravel to deposit about the holes. Obviously they were the excavation crew and they were working just as hard as the bacon bringers. The upper holes were at least ten feet from the embankment, so they must have had quite an underground community.

I have never seen a more perfect example of co-ordinated effort and team work; an example the human race might study and profit by. Perhaps the chap who said the ants would inherit the earth knew, after all, what he was talking about.

Save the Snakes

Inspired by our recent publication of a letter emphasizing the importance of hawks in rodent control, Wally Christian of Dallas, Texas, steps forward in behalf of snakes. He writes:

"Even more persecuted than the hawks are our harmless snakes. It has been estimated that nearly six million snakes are killed annually in the United States. At least half, and probably more, are the rodent-eating kinds. A snake three feet or larger will eat as many as a hundred noxious rats or mice yearly. As a rat will eat more than a pound of grain a week, you can see the great damage done by this wholesale slaughter of harmless serpents. If the dyed-in-the-wool snake killer would spend a little time reading up on the beneficial habits of our non-venomous snakes he would cease to consider them as detestable creatures."

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TEN-YEAR INDEX

While there was a very good response to the inquiry carried in the magazine asking those who wish a ten-year index to the second ten years of Nature Magazine to indicate their desire for same—and willingness to pay up to $1.50 a copy—the number desiring this index was not large enough. There is a very considerable expense involved in compiling such an index, not to mention a tremendous amount of work. For the time being, therefore, it will be necessary to rely upon the index to the first ten years of Nature Magazine, and the very thorough indexes that appear in the June and December issues from 1932 to 1937, inclusive, and in the December issues since 1937. Even without a second ten-year index, these indexes to each volume make Nature Magazine a valuable reference work.

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